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THESIS

THE BRAZILIAN AEROSPACE INDUSTRY: A CASE STUDY OF THE TECHNOLOGICAL IMPACT OF OFFSET AGREEMENTS IN A RECIPIENT INDUSTRY

by

Julio Eduardo da Silva Menezes

December, 1989

Thesis Advisor: Edward J. Laurance

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The Brazilian Aerospace Industry: a Case Study
of the Technological Impact of Offset Agreements
in a Recipient Country

by

Julio Eduardo da Silva Menezes
Lieutenant, Brazilian Air Force

Submitted in partial fulfillment
of the requirements for the degree of

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December 1989

ABSTRACT

This thesis examines the role of technology in determining the technological independence, national security enhancement, and economic benefits which occur as a result of military offset agreements in recipient countries. The study defines trade offsets and interprets the Brazilian government's offset and technology transfer policies. Using cases from the Brazilian aerospace industry, the researcher performed an analysis of four types of offsets (countertrade, technology transfer, licensed production, and coproduction) to test the hypothesis that technology is the driving factor in the design of offset requirements for recipient countries. The thesis concludes with some recommendations to improve the Brazilian government's offset policy and decision-making process.

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Finally, this thesis is dedicated to the professional people in Brazilian government and industry who struggle daily to do their jobs, while balancing the benefits of technological innovation against the economic problems that a developing country has to confront. The search for a viable but streamlined national policy certainly is their dream.

I. INTRODUCTION

The hypothesis of this thesis is that technology is the main factor that motivates developing countries to require offset agreements for improving indigenous arms industries. Offsets are those arrangements made whereby recipient countries require compensation as a condition of purchase of military related exports, with the intention of creating benefits for the buyer.

The most critical research lacunae in offset and technology transfer is the lack of studies about the impact of these concepts in a recipient country. Many studies have been developed by U.S. governmental agencies and industries associations to identify the offsets' impact on the U.S. economy [Ref. 1 and 2]. Some internal concerns are the negative impact on jobs in the supplier country, increasing foreign competition and the long-term effect on its industrial base. External concerns rest primarily with technology transfer to countries that do not have barriers to retransfer this technology to non-allied countries [Ref. 3].

Some U.S. government officials and Congressmen are asking for a unilateral supplier position which denies offset agreements, but they cannot agree with defense industrial representatives who are concerned with continuing to sell their products in a more and more competitive and unknown market where the buyer has the power to negotiate conditions [Ref. 4].

In the middle of this debate are voices asking for a multilateral agreement among nations, but the basis for negotiating this agreement does not exist because

the reasons for recipient countries requiring offsets are not well identified[1].

The favorable voices for the multilateral approach come from recipient countries. They say that offsets offered by the U.S. never represent technological nor operational advantages and they do not include the **systems integration work**, so keeping for the U.S. the control and management of different subsystems and also the total systems [Ref. 6]. They also say that most offset agreements rarely meet expectations when implemented [Ref. 5]. But, what is the real importance of offset agreements for recipient countries?

A. BACKGROUND

Brazil is the leading Third World[2] exporter and third-ranked arms producer and is considered to have the greatest potential for growth in arms production [Ref. 7], or with a chance to remain so [Ref. 8]. Specifically the Brazilian aerospace industry has had great success in developing and producing aircraft and missiles since the mid-1970's, when it started exporting its products of high-quality, medium-to-low technological range of weaponry at very competitive prices. The Brazilian aerospace industry can independently design and produce light aircraft, coproduce jet fighters, and produce tactical missiles under licensed production [Ref. 8:p. 15].

---

[1]The OMB study stated that the reasons for recipient countries seek for offsets help explain the effect offsets have on the U.S. trade [Ref. 5].

[2]The term "developing" and "third world" are used to mean all nations except: members of NATO and the Warsaw Pact, other European countries not belonging to either alliance, Japan, Australia and New Zealand (see Arms Control and Disarmament Agency - ACDA)[Ref. 8].

The lesser degree of sophistication of these systems, which do not demand specialized operators or maintenance personnel, may well be appropriate to the level of training prevailing in many third world countries [Ref. 8:p. 22].

Although its major aircraft still include imported components, Brazilian designers and manufacturers have shown considerable skill in making well-conceived aircraft. One example of these new products is the Tucano Turboprop trainer aircraft that has found technically capable customers such as British Royal Air Force (RAF) and U.S. Air Force (which was searching for alternatives after its Fairchild new trainer program was cancelled). The interesting fact is that RAF's first order of 130 Tucanos call for a license production of the aircraft, a notable reverse-flow of technology [Ref. 9].

Brazil founded its capabilities on licensed foreign arms designs, tooling, hands-on-training, and joint ventures or partnerships with established producers. As the industry has matured, it has gone on to develop its own military systems. It is therefore quite appropriate to select Brazil as the source of case studies.

B. PURPOSE OF THESIS

There are many aspects to an offset study -- arms transfers policy, international trade and competition, economic incentives, etc.

The purpose of this thesis is to analyze the way in which the Brazilian government and industry decide about technology in negotiating these agreements. Brazil has engaged in various joint projects to codevelop and coproduce aircraft, assemble helicopters, license missiles and aeronautical engines, and acquire satellite and rocket technology from different countries.

Relative success in absorption of technology by the aerospace industry has been supported through a very detailed and particular Aeronautics Ministry policy inside of the Brazilian government.

The goal of this thesis will be to determine the impact of the military offset agreements on the technological process of developing countries and to draw from the analysis of the offset decision process some broader theoretical implications, especially for that body of technology transfer theory which purports to explain and predict technological behavior of recipient countries.

C. SCOPE OF THESIS

Brazil's arms production does not consist only of aerospace products. However, analyzing the entire spectrum of lighter tanks, ships, submarines, and a variety of other Brazilian made weapons is a topic that is much too broad for the limited scope of this research[3].

Some explanation should be made about the choice of Brazil as a case study even though other countries such as Canada, Australia, Israel, and NATO countries have devised specific offset requirements and complex formulas for evaluating offset packages, usually emphasizing technology transfer [Ref. 10]. So, why the Brazilian case? First, the technological impact seems to be more evident in a New Industrialized Country (NIC) than in Less Developed Countries (LDC) and developed nations. Second, there are other countries similar to Brazil which could share the knowledge as to how get most of the benefits from these offset

---

[3]For an overview of Brazilian arms products, see **Brazilian Defence Equipment 1988-1989** [Ref. 57].

negotiations and continue their process of development, in spite of the economic problems caused by their high indebtedness. Third, the Brazilian government, specifically the Aeronautics Ministry, is regulating the offsets for general aircraft imports, applying models from other countries with the risk of misapplying traditional recipes for different situations. Finally, the Brazilian aerospace industry represents an example of survivability in a highly competitive and depressed international market and most of this success is due to a synchronized Government policy and well defined technology objectives.

D. LIMITATIONS AND ASSUMPTIONS

This thesis is purposely limited to four types of offset agreements (countertrade, licensed production, technology transfer, and coproduction) made in connection basically with military and civil aircraft and helicopters, and telecommunications systems acquisition, most of the time involving government-to-government transactions. The concentration on these offsets is done because it is these that contain specific commitments for Brazilian government participation and involve the application of technology as the main arrangement.

The research limitations of this thesis include the lack of previous academic studies in this specific area and the problems in developing empirical indicators which lend themselves to modeling and statistical tests.

Various other factors limited this research. Some of them were due to distance, getting information which most of the time existed in Brazil but not compiled in an adequately usable form. Some data are considered confidential or

proprietary, and young industries and a paternalistic Government will try to defend a valued treasure from plunder[4].

A complete search of the huge trade literature published in many magazines and journals showed only the "tip of the iceberg", and from this point, we start this research with some assumptions[5]:

- It is assumed that the reader has a basic familiarity with international trade for civilian merchandise. Therefore, specific economic aspects, also applied in trading military products such as comparative advantage, economies of scale, and multiplier effects are not covered[6].

- It is assumed that an aerospace industry cannot be supported technically only with military production and that producers of dual purpose equipment are more affected by technological changes.

- It is assumed that most of the Brazilian government's decisions have strong commercial influence. This is due to the peculiarly close relationship between government and industry in government-owned companies ("estatais"). Therefore, decisions that some industrial managers make, even physically outside the government, are considered government decisions, or at least with government support.

- Some analysts object to the use of "contract" or "agreement" figures due to the uncertainty and changes that they are subject to. For this study, it is assumed that an offset proposal is a real indication of measurement of offset and technology demand.

---

[4]Data collection will be discussed later in the methodology section.

[5]The assumptions are chosen for simplicity and clarity, and no attempt is made at generality.

[6] For definitions see **Economics; Principles and Policy** [Ref. 58].

E. METHODOLOGY

This section examines the research method and its applications in developing the theoretical framework to analyze the technological impact of military offsets in a recipient country.

1. General Methodological Theory

According to Earl Babbie [Ref. 11], we live in a world of two realities: **agreement reality**, where the things are considered to be real because you have been told they are real and **experiential reality**, where you know things are real as a function of your direct experience. The problem is that both seem very real. How can you really know what is real? Science offers an approach to both agreement reality and experiential reality. Scientists have certain criteria that must be met before they will accept the reality of something they have not personally experienced. The special approach to the business of inquiry is called **methodology** or "the science of finding out".

Other concepts inherent to human inquiry are causality and probability. If you can understand why things are related one to another, why certain regular patterns occur, you can predict even better than if you simply observe and remember these patterns.

A distinguished historian of the Renaissance, Jacob Burckart, remarked that the true use of history is not to make men more clever for the next time but to make them wiser forever. As we know, it is not an easy task to learn from past experience. Some people disagree that this is not a correct lesson from a particular

case or if it is a correct lesson, people often misapply those lessons to a new situation [Ref. 12].

But how can previous experience be applied to the decision making process? The best way is converting the "lessons" of a variety of historical cases into a comprehensive **theory** that encompasses the complexity of the phenomenon or activity [Ref. 12]. This is the approach chosen for this thesis.

2. Why Case Study Methodology?

Most of the case study methodology used in this thesis comes from Yin [Ref. 13] and George [Ref. 12] whose works offer excellent guidelines in applying this method.

Case study has long been stereotyped as a weak sibling among social science methods. Researchers who do case studies are criticized because their investigations have insufficient precision, objectivity, and rigor. In spite of this, case studies continue to be used extensively in social science research. This thesis is one example of the application of the case study method.

The case study method was chosen due to its facility in handling complex problems about a contemporary set of events, over which the researcher has little or no control. The method also fitted with the "why" and "how" type of questions.

Some concerns in using this method were the inexperience of the researcher, its lack of rigor, the difficulty in making scientific generalizations from a few cases, and that it normally takes too long and results in massive and unreadable documents.

3. Research Design

The phenomena to be studied are the offset arrangements for arms deals and their impact on recipient countries. Specifically, the **research problem** identified is that there are many motives for recipient countries to enter into offset arrangements. Many nations have devised specific requirements and complex formulae for assessing the relative merit of offset alternatives, usually emphasizing technology transfer [Ref. 10].

Specifically Brazil has evaluated favorably those offsets which provided independent technological capabilities, enhance national security, and improved economic benefits. These are the three outcome variables in this thesis. The major hypothesis tested in this thesis that the most important factor correlated with offset outcome, in terms of these three outcome variables, is technology.

There are two **research objectives** for this thesis: the scientific objective is to acquire knowledge about how the technology factor determines the design and effects of offset requirements in developing countries, specifically Brazil. The policy objective of this research is to provide the Brazilian government and defense industries with an analytical framework that facilitates the policy and decision-making process concerning the technological requirements in future offset agreements negotiations.

4. Definition of the Variables

After investigating and rejecting the feasibility of developing an empirically based model, it became apparent that a more conceptual approach was required. The following discussion explains how the initial framework was developed.

How does **technology** relate to **offset** arrangements in the arms trade? This question is basic to developing a framework of independent and dependent concepts and variables that can be used to describe the technological impact in recipient countries.

a. Independent Variables

What are the independent variables which determine the **offset outcome?** The remaining questions are about four basic independent factors and its conception definition:

(1) Technological Factors

Q1) What **type of technology** is (was) being transferred?

This variable is used to define the various characteristics of product design and the relative sophistication of production techniques.

Q2) What is (was) the technology **transfer environment**?

This includes the influence of stage of industrial development, sizes of internal and external markets, policies of protection, and exchange controls.

Q3) What are (were) the **recipient firms'** characteristics?

This considers the technical absorptive capacity and potential in competitive markets of the recipient firm.

Q4) What are (were) the **supplier firms'** characteristics?

This considers the technology capability, R & D position, and corporate philosophy of the supplier firm.

Q5) Is (was) this **technology integrated**?

This is aimed at evaluating the capacity of the recipient to absorb and transform the technology.

(2) Economic Factors

Q6) Does (did) the offset agreement **conserve foreign exchange**?

The conservation of foreign exchange is a measure of the economic benefits in saving hard currency as the final balance of one offset transaction ("apparent savings"). It includes also the possibility of savings through future exports ("future savings") and the absence of using hard currency in an offset transaction, producing savings for other transactions that cash would be required ("opportunity savings").

Q7) Does (did) this agreement **create jobs**?

Each offset agreement should be evaluated in light of the job impact its section will have on the labor force[7].

Q8) Does (did) this offset **improve exports**?

This attempts to measure if the offset agreement will (did) improve the level of aerospace products exports.

Q9) Does (did) this agreement **enhance the financial** project **viability**?

The objective here is to identify if the offset received some portion of foreign direct investment or if it is being used as a financing tool.

---

[7]The employees shifting from other industries are assumed to be job creation because of the difficult in distinguishing employee origin.

(3) Socio-Political Factors

Q10) What are (were) the **internal and external political motivations** for this agreement?

This variable will emphasize the role that domestic and international political priorities play in the ultimate contract and respective offset agreement decision and selection.

Q11) How does (did) the **government act** in this offset?

In an offset agreement the recipient government's action is fundamental. The direct role of the Brazilian government is identified as negotiation assistance, support (financial, material, transport, incentives), and controller type actions.

Q12) What are (were) the **political and social pressures** of this agreement?

This variable evaluates the level of influence from the various groups of the Brazilian society such as: Congress, Military, Industry, and Labor Unions.

(4) Military Factors

Q13) What are (were) the benefits of this agreement for **industrial defense**?

This variable measures the level of contribution that the offset agreement added (will add) to Brazilian national defense industry.

Q14) Does (did) this agreement bring **International prestige**?

International prestige represents the level of other countries' psychological perception of the benefits obtained by Brazil as a result of this offset agreement. How will the other countries interpret this offset?

Q15) How does (did) the technology embodied in this offset improve the national **military capability**?

Military capability is defined as the contribution of this offset agreement is giving to improving quantitatively and qualitatively the Brazilian armed forces inventory.

Q16) How does (did) this agreement contribute to the country's **independence and non-vulnerability**?

This variable is intended to evaluate or to estimate if the level of independence and non-vulnerability in arms production after the offset agreement obligations completed were (will be) improved[8].

b. Dependent Variables - Offset Outcome

The following four questions deal with offset outcome:

Q17) What are (were) the **offset agreement characteristics**?

They are: type, direct or indirect, offset percentage, time of implementation, method of enforcement, financial arrangements, and "end-user" clause[9].

---

[8]For example Chile bought some F-5 fighters from the U.S some years ago. Today, for political reasons, the U.S Government is not issuing Chilean export licenses to the fighter suppliers [Ref. 57].

[9]"End-user" clause is understood to be when the offset agreement establishes a legal constraint for future recipient countries exports connected with the technology transfer.

Q18) Does (Did) this offset agreement provide **independent technological capabilities**?

The independent technology capability is understood to mean the capacity to develop and produce better equipment with the technology transferred through the offset agreement.

Q19) Does (Did) this offset enhance **Brazilian national security**?

This variable measures the level of contribution that the offset agreement offers to reduce national insecurities and threat perception, as defined in the Basic Manual - Manual Básico of the Brazilian National War College - Escola Superior de Guerra (ESG) [Ref. 50:p. 53].

Q20) Does (Did) this offset improve Brazilian **economic benefits**?

An attempt will be made to assess the potential or past positive effect on the Brazilian economy.

The complete diagram of the framework can be found on **Tables 1 and 2**. The complete descriptions of the variables are presented in Chapter Two, within the offset concept section.

These variables give the best approximation of what offset outcome is from the economic, socio-politic, military, and technical point of view.

5. Case Studies

The cases were chosen from a long list of Brazilian offset agreements, based on the following criteria:

First, cases should be related to the aerospace industry. The Brazilian aerospace industry involves aircraft, helicopters, missiles and rockets, satellites and

TABLE 1

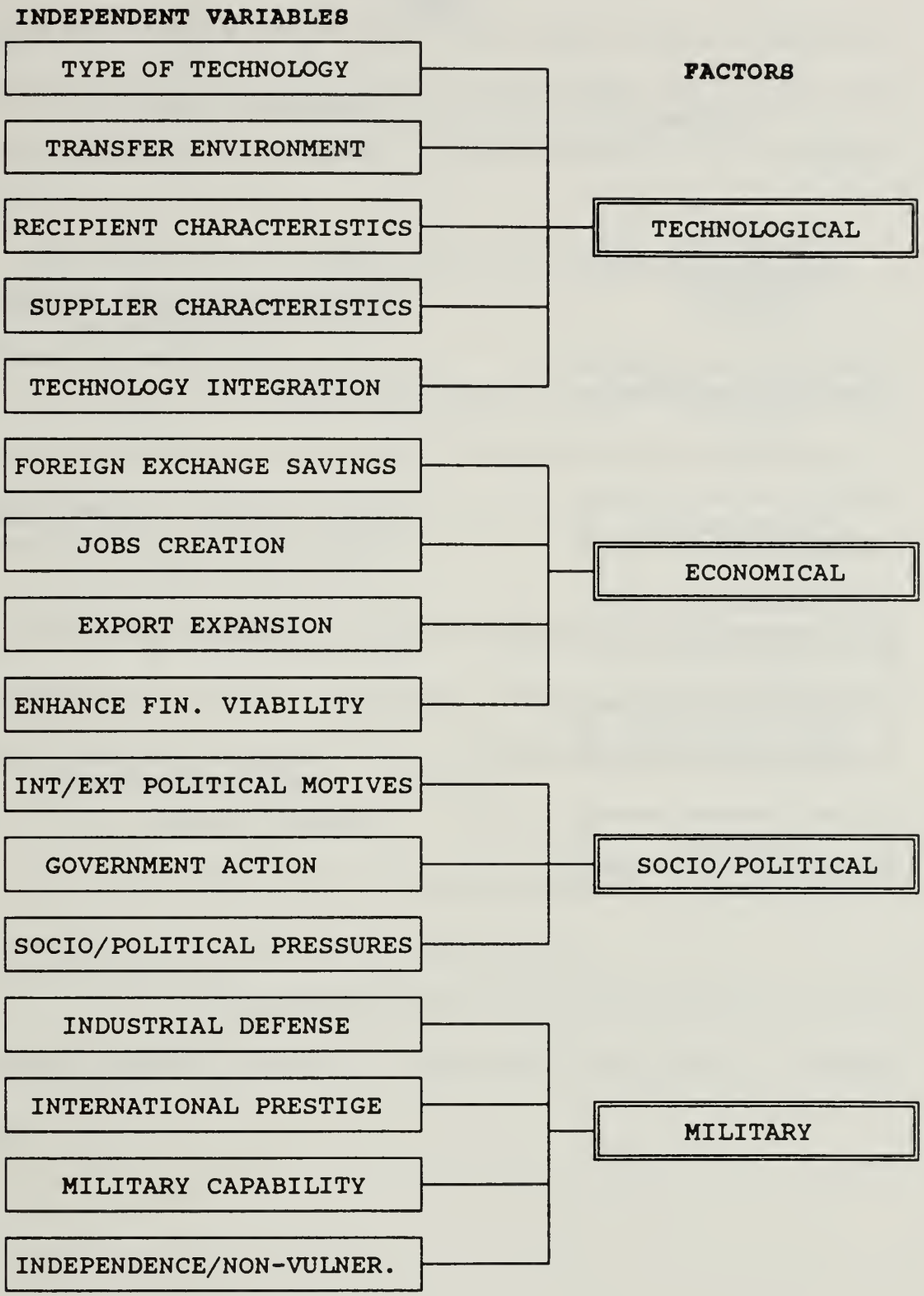
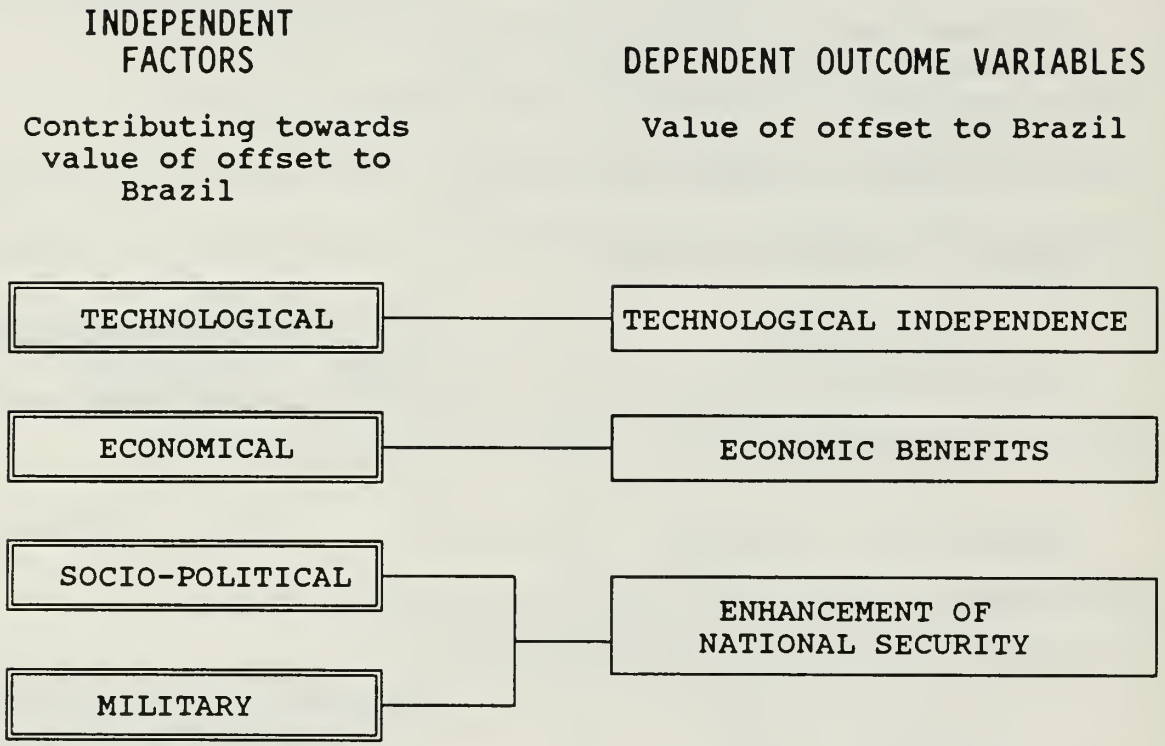

INDEPENDENT VARIABLES
TYPE OF TECHNOLOGY
TRANSFER ENVIRONMENT
RECIPIENT CHARACTERISTICS
SUPPLIER CHARACTERISTICS
TECHNOLOGY INTEGRATION
FACTORS
TECHNOLOGICAL
FOREIGN EXCHANGE SAVINGS
JOBS CREATION
EXPORT EXPANSION
ENHANCE FIN. VIABILITY
ECONOMICAL
INT/EXT POLITICAL MOTIVES
GOVERNMENT ACTION
SOCIO/POLITICAL PRESSURES
SOCIO/POLITICAL
INDUSTRIAL DEFENSE
INTERNATIONAL PRESTIGE
MILITARY CAPABILITY
INDEPENDENCE/NON-VULNER.
MILITARY

TABLE 2

INDEPENDENT FACTORS AND DEPENDENT VARIABLES



engines. Second, the offset agreements should involve military products. The thirdand most important criterion was to choose cases involving varying levels of technology transfer. The last criterion was more flexible. Civilian cases could reinforce the data if for some reason the previous cases were not supported by data.

From **Table 3**, only the following cases were chosen to be analyzed:

a. Countertrade

(1) MD-11 Aircraft - McDonnell Douglas and EMBRAER production of the outboard flaps in connection with VARIG Brazilian airline acquisition of 10 MD11 aircraft.

b. Technology Transfer

(1) BRASILSAT Program - Various U.S. and other countries' industries offset proposals to TELEBRAS (Telecomunicações Brasileiras) and Aeronautics Ministry for the acquisition of two satellites and launch services.

c. Licensed Production

(1) PIPER Models - PIPER and EMBRAER contract to assemble knocked down parts of five models of civilian aircraft.

(2) Aérospatiale Helicopters - Aérospatiale (France) and HELIBRAS contract to assemble knocked down parts of military helicopters for the Brazilian Army.

Table 3

BRAZILIAN AEROSPACE OFFSET AGREEMENTS

EQUIPMENT/TECHNOLOGY	TYPE	OFFSET	MANUFATURER	SUPPLIER	SOURCE
DACTA SYSTEM	ADS	L	MAER	FRANCE	THOMSON-CSF
COBRA 2000	ATM	L	MAER	FRG	MBB(FRG)
HB-350B ESQUILO	HEL	L	HELIBRAS	FRANCE	AÉROSPATIALE
HB-315B GAVIÃO	HEL	L	HELIBRAS	FRANCE	AÉROSPATIALE
EMB-326 XAVANTE	TRN	L	EMBRAER	ITALY	AERMACCHI
AMX	FTR	C	EMBRAER	ITALY	AERMACCHI/AERITALIA
F-5	FTR	L	EMBRAER	USA	NORTHROP
COMPOSITE MATERIALS	TEC	L	EMBRAER	USA	SIKORSKY
CBA-123	TRA	C	EMBRAER	ARGENTINA	FAMA
PIPER MODELS	COM	L	EMBRAER	USA	PIPER
ECUREIUL/DAUPHIN	HEL	L	HELIBRAS	FRANCE	AÉROSPATIALE
BRASILSAT I AND II	SAT	T	TELEBRAS	CANADA	SPAR/ARIANESPACE
SPEY MK-807	ENG	L	CELMA	UK/ITALY	ROLLS-ROYCE/FIAT
MD-11	COM	CT	EMBRAER	USA	MCDONNELL DOUGLAS

ADS -
ATM - ANTI-TANK MISSILE
HEL - HELICOPTER
TRN - TRAINER AIRCRAFT
FTR - FIGHTER AIRCRAFT
TEC - TECHNOLOGY
ENG - ENGINE
COM - COMMERCIAL AIRCRAFT
TRA - TRANSPORT AIRCRAFT
LIC - LICENSE PRODUCTION
COP - COPRODUCTION
TT - TECHNOLOGY TRANSFER
CT - COUNTERTRADE

SOURCE: Louscher, David J. and Michael D. Salomone, Marketing Security Assistance: New Perspectives on Arms Sales, Lexington Books, 1987, pp.118-119.

d. Coproduction

(1) CBA - 123 Program - EMBRAER and FAMA (Argentina) codevelopment and coproduction agreement to produce a 19-seat turboprop civilian aircraft.

(2) AMX Program - Brazil and Italy codevelopment and coproduction agreement, involving various defense industries, to produce a fighter aircraft.

6. Hypotheses

The cases above were carefully chosen to provide variance in experience in negotiating offsets, types of offset agreements, civilian and military offsets, levels of technology transfer, intensity of government support, and origins of the suppliers.

The hypotheses (if/then propositions) that will be tested are:

- **H1:** IF variance in **experience in negotiating offsets** affects the **offset outcome**, THEN there is a learning process in recipient countries offset negotiations, which will result in increasingly beneficial offsets over time.
- **H2:** IF variance in **types of offset agreements** affects the offset outcome, THEN there is a trend that shows an evolution among different agreements.
- **H3:** IF variance between **military and civilian offsets** affects the offset outcome, THEN the government should give different treatment to civilian and military offset policy (different legislation, assistance, financial support, etc.).
- **H4:** IF variance in **level of technology** affects the offset outcome, THEN there is a hierarchy among different offset agreements (i.e., some offset agreements are able to transfer technology better or more efficiently).
- **H5:** IF variance in **government support** affects offset outcome, THEN defense industries should search for offset agreements with government

support (i.e., there is some suspicion that recipient industries have more leverage in negotiating offsets if they have their government involved.).

- **H6:** IF variance in **supplier countries and industries** affects offset outcome, THEN recipient governments and industries should develop "supplier scores" to improve decision making (e.g., a databank with previous information by country and by industry, about implementation, policies, trade barriers, etc.).

7. Data Collection

Since the increase in international arms transfers after the 1970s, social and political scientists have studied various aspects of arms transfers and drawn conclusions from existing data. These studies have produced questions concerning the validity and accuracy of the data. This is especially problematic since those data are especially "unreliable and open to manipulation" [Ref. 14]. This subsection analyzes some of the data sources available for data collection for this research.

There are basically two institutions that put out arms transfer data: The **Stockholm International Peace Research Institute (SIPRI)** and the **U.S. Arms Control and Disarmament Agency (ACDA)**. Some studies (Brzoska, 1982 [Ref. 14], Laurance and Sherwin, 1978 [Ref. 15] and 1979 [Ref. 16], and Kolodziej, 1979 [Ref. 17] offer analyses which compare SIPRI and ACDA data. They present the limitations of both sources, present some differences, and examine their **validity** and **reliability**[10]. For the purpose of this research, involving offset information and statistics, the following issues should be discussed:

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[10]**validity**: "A measure or indicator is valid if it is an adequate measure of what it is supposed to represent".

reliability: "A particular measurement procedure is reliable to the extent that it yields results that are consistent in successive measurements of the same case, and comparable among cases"[Ref. 16].

- ACDA and SIPRI sources have limited use in studying individual industries. ACDA gives figures for total exports but does not contain information on types and quantities of equipment transferred, while SIPRI gives information about different arms production firms, but without the detail required.

- ACDA and SIPRI sources do not provide information on direct costs accruing to recipient countries, correct time for delivery, negotiations in progress, and technical information of the weapons. ACDA does not include training, technical services, and construction information.

The others sources of specific offset statistics are in the OMB [Ref. 1] and DT/AIA/EIA [Ref. 2] studies, but the aggregation of values required to protect proprietary data did not allow a more in-depth analysis of Brazilian cases negotiated with the U.S. Also, the U.S Department of Commerce statistics do not identify sales contracts with offsets even for civilian aircraft. The same occurs with CACEX (Brazilian trade department) statistics.

The search of Brazilian sources of statistics was frustrating. Due to the fact that offset is a new topic in Brazil only a few articles were found and they produced contradictory information increasing the reliability problem.

In summary, different theoretical and practical questions demand different arms transfer data. The researcher interested in technological impact of offset in recipient countries needs the following basic data: hardware data sorted by supplier and recipient firms; data on pricing of individual items to access the difference of prices with/without offsets, percentage of technology transfer agreements in connection with the main agreement, and time for offset implementation[11]. This data is not currently available and had to be generated for this study.

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[11]See offset definitions in Chapter Two.

8. Generalization

The case studies in this thesis will provide findings regarding the technological factor in offset arrangements. But they also yield another benefit. Together with the previous studies, these case studies provide a basis for formulating generalizations relating to four significant issues expressed by the following questions:

- What are the determinants of offset requirements?
- What is the relationship of different offset factors?
- What is the link between offsets and technology transfer?
- What are effective offset policies for developing countries?

F. LITERATURE REVIEW

Several sources have addressed the issue of offset trade and technology transfer. For this study four topics were identified which supported the scope of this thesis.

The first category is information on arms transfers and production in third world countries. Of these sources, DOD [Ref. 18], SIPRI [Ref. 7], ACDA [Ref. 8], Louscher, David, and Moniz [Ref. 19], and Katz [Ref. 20] were the most complete.

The second category of published work includes offset trade. An extensive literature covers the different types of civilian offsets but very few address the military aspects. This last part is superficially covered by articles in various defense magazines. The official reports of OMB [Ref. 18] and the DT/AIA/EIA [Ref. 2] are the most complete studies. Some individual works by Neuman [Ref. 3], Schmidt

[Ref. 10], and Welt [Ref. 21] offer excellent points for discussion and recommendations for further research. Countertrade theory and issues have more emphasis in East-West than North-South trade. Some organizations issued reports -- OECD [Ref. 22], Business International Corporation [Ref. 23], and U.S. Department of Commerce [Ref. 24]. Some expert opinion on the subject is found in Banks [Ref. 25], Mirus and Yeung [Ref. 26], Hennart [Ref. 27], Korth [Ref. 28], Verzariu [Ref. 29], Jones [Ref. 30], Schaffer [Ref. 31], Welt [Ref. 32], and Maynard [Ref. 33]. License agreements are studied basically in Contractor [Ref. 34 and 35]. Aerospace coproduction is well explained in two RAND reports [Ref. 36 and 37]. Joint ventures general theory may be found in Harrigan [Ref. 38] and Killing [Ref. 39].

The third category in the literature, technology transfer theory, contained many studies. Key works used were: Barason [Ref. 40 and 41], Rogers [Ref. 42], Wallender [Ref. 43], and Singh [Ref. 44]. The literature of science and technology policy in Brazil reviewed in Erber [Ref. 45], and World Bank [Ref. 46], gives the entire view of Brazilian industrial policies and manufactured exports. Dagnino [Ref. 47 to 49] offers an excellent overview about the technology issue in the Brazilian arms industry.

The last category, surprisingly well covered, gives general information of the Brazilian aerospace industry history and main programs. However, in regards to the specific about the cases studied, personal interviews, telephone conversation, and correspondence with the industries were needed to complement the data about the case studies.

Theses and dissertations on the topic were surprisingly rare. Mckenna [Ref. 51] and Moses [Ref. 52] talk about military offset. On the subject of Brazilian arms trade and foreign policy Tollefson [Ref. 53], Mura [Ref. 54], and Ellis [Ref. 55] are excellent sources. Specifically regarding the Brazilian aircraft industry, an update overview is presented by Reiners [Ref. 56].

G. ORGANIZATION OF STUDY

In Chapter One, the introduction and methodology is discussed. Chapter Two addresses offset trade and technology transfer theory with focus on the scope of this thesis. Chapter Three focuses on some governments' offset policies in managing and supporting offset trade, with emphasis on Brazilian offset policy. Chapter Four researches the Brazilian aerospace industry, dividing it basically into aircraft industry and space industry. Chapter Five performs the case studies analysis of four types of offsets: countertrade, technology transfer, licensed production, and coproduction. Chapter Six offers, as an outcome, the analysis based on the hypotheses previously stated and makes some generalizations from the Brazilian cases.

The conclusion presents the main findings of the study as a guide the decision-making in Brazilian offset agreements. Recommendations to improve Brazilian offset policy and for further research are presented.

II. OFFSET AND TECHNOLOGY TRANSFER CONCEPTS

This chapter presents a background of offset trade and technology transfer concepts and introduces some of the types that will be discussed in more detail in Chapter Five[12]. The **first section** defines the various types, terms, and structures of offsets, gives a short background of this concepts, presents the supplier's motivations toward offsets, and characterizes the recipient's motivations within four main offset factors that will be the basis of the theoretical framework used to analyze the Brazilian cases. They are technological, economical, socio-political, and military factors. The **second section** presents a conceptualization of technology transfer applied to offset and discusses the application of military technology in commercial business.

A. OFFSET TRADE CONCEPT

Offset is an umbrella concept that covers a broad range of complex compensatory terms by foreign trade partners as a condition of sale, particularly for military and aerospace products.

Offset agreements are very flexible and they allow many combinations of different contracts at the same time. Weapons in exchange for Yugoslavian hams and Greek tourism are some examples of this flexibility.

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[12]A more detailed description of each offset type will be presented in Chapter Five, before each set of cases. This is to facilitate understanding and association between the case and its respective offset theory.

1. Definitions, Terms, and Structures

There is a great deal of confusion regarding terminology. Some authors differentiate between offset and countertrade, meaning military and civilian compensatory arrangements respectively. Others say that offset is the principal form of countertrade in the aerospace industry [Ref. 1:p. 61]. To clarify terminology and to attempt to differentiate between military and civilian cases, this difference is expressed as "military offsets" and "civilian offsets", reserving the term countertrade as a major type of the basic concept of offset[13].

a. Definitions

Because the term "offset" has been used with different meanings in worldwide trade, it is important that the reader be aware of how the term is defined for this thesis. Among numerous sources researched, it was decided to adopt the Office of Management and Budget (OMB) formulations due to its emphasis on military trade and also due to its cumulative experience in researching offsets during four consecutive years[14]. OMB reports also are considered the most complete official study about this subject at this writing [Ref. 3].

The industrial and commercial definitions applied to offset used by OMB and from now on applied in this research are:

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[13]See Neuman [Ref.2] to understand better this "frustrating and thankless task" of differentiating between them. The author is responsible for any errors in interpretation or judgment in terminology.

[14]OMB annually reports has been published since 1985.

(1) OFFSET: A range of industrial and commercial compensation practices required as a condition of purchase of military exports[15]. The various types of offsets are defined as:

- **COPRODUCTION** - Overseas production based upon government-to-government agreement that permits a foreign government(s) or producer(s) to acquire the technical information to manufacture all or part of a supplier country origin defense article. It includes government-to-government licensed production. It excludes licensed production based upon direct commercial arrangements by supplier country manufacturers.

- **LICENSED PRODUCTION** - Overseas production of a supplier-origin defense article based upon transfer of technical information under direct commercial arrangements by supplier country manufacturers.

- **SUBCONTRACTOR PRODUCTION** - Overseas production of a part or component of a supplier country-origin defense article. The subcontract does not necessarily involve license of technical information and is usually a direct commercial arrangement between the supplier country manufacturer and a foreign producer.

- **OVERSEAS INVESTMENT** - Investment arising from the offset agreement, taking the form of capital invested to establish or expand a subsidiary or joint venture in the foreign country.

- **TECHNOLOGY TRANSFER** - Transfer of technology that occurs as a result of an offset agreement and that may take the form of: research and development conducted abroad, technical assistance provided to the subsidiary or joint venture of overseas investment, or other activities under direct commercial arrangement between the supplier country manufacturer and a foreign entity.

- **COUNTERTRADE** - In addition to the types of offsets defined above, various types of commercial countertrade arrangements may be required. A contract may include one or more of the following mechanisms:

  - **Barter** - A one-time transaction only, bound under a single contract that specifies the exchange of selected goods or services for another of equivalent value.

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[15]This military definition is extended to include transactions of general aviation aircraft and satellites. This is due to the close relationship of these equipments with the military equipment and the high value of these transactions.

- **Counterpurchase** - An agreement by the initial exporter to buy (or to find a buyer for) a specific value of goods (often stated as a percentage of the value of the original export) from the original importer during a specified time period.

- **Compensation (or buy-back)** - An agreement by the original exporter to accept as full on partial repayment products derived from the original exporter product.

Within the business community, offsets associated with military exports are frequently divided into direct and indirect classes:

- **DIRECT OFFSETS** - Contractual arrangements that involve goods and services addressed in the sales agreement for military exports.

- **INDIRECT OFFSETS** - Contractual arrangements that involve goods and services unrelated to the exports referenced in the sales agreement.

Offsets may involve any of the above arrangements or may incorporate elements from several of them. The most common types of offsets can be structured as either direct or indirect, and sometimes as a combination of the two.

b. Terms

Some points in terminology must be addressed to show a distinction similar to the situational difference between arms orders and the actual delivery. Not all offset agreements signed are implemented.

Obligation in offset agreements is the offset value agreed upon within a sales contract. **Implementation** is the value of those offsets actually implemented. The latter's value may never be the obligated value, therefore real implemented offsets are a better measure of economic impact. Implementations lead-time is also important to measure their influence in the age of technology.

Another term used in offset agreements refers to the obligation enforcement used by the recipient country. The idea of recipient country enforcement rests basically on two approaches; **"best-effort"** or **"best endeavor"** are the preferable terms in these agreements though they don't seem very enforceable. **"Liquidated damage"** includes a penalty on any unfulfilled portions of the offset commitments to be paid as a fine. This approach is largely used nowadays, and usually is negotiated as a percentage of the total value of the offset agreement.

c. Structure

Offsets may involve any of the above arrangements or may incorporate elements from several of them. The idea to establish a framework upon which offset arrangements are structured is somewhat difficult due to numerous differences from one case to another. Not all offset agreements have all of the elements that others do, and in some cases, individual pieces of the framework are used differently than in others. These differences are not substantive; rather they usually reflect the peculiarities of the particular case at hand and the individuality of the drafter of the agreement. Some experts agree that offset agreements tend to be more comprehensive than their predecessors, indicating a learning curve phenomenon at work [Ref. 4].

The clauses that are negotiated in offset agreements generally are originated from an offset proposal. From the literature available[16], the main items

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[16]It was difficult to access any original offset agreements. Most of them are government-to-government agreements and they are not available for public release. The same occurs with the private companies agreements.

stated in an offset proposal and consequent offset agreement are: the tendered price (the share of offset of the total price), the value of recipient products, the value and nature of direct and indirect works, the penalties, the period over which offset commitments are to be achieved, and the extent of achievement of pre-existing offset obligations and current action to fulfill these obligation [Ref. 5:p. 290].

2. Background

Offsets arose in the late 1950s and early 1960s in response to the legitimate need to rebuild the industrial base for defense in Western Europe and Japan. At that time, offset agreements may have been justifiable for reducing the impact of military equipment purchases on the budgets and trade accounts of these countries. Offsets have contributed to standardizing and modernizing the arms inventories of the alliance, and to strengthening transatlantic ties in defense of NATO countries [Ref. 6].

Offsets also contributed to commerce with the Eastern Bloc due to the impossibility of exchanging their currencies into the Western market. These practices soon spread to developing countries because of numerous reasons[17].

Now, times and circumstances have changed, but offsets remain. The new concept of offset is a relatively new development for most defense companies and governments that are now involved in it. Although some of the basics are old

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[17]The reasons for developing countries engaged in offsets will be discussed later on this chapter.

(e.g., barter is the oldest method of business transactions), its modern sophistication is new and dynamic.

During this research, several previous studies and surveys were consulted[18]. Although most of them represent one sample related to U.S. industries, their results were considered as the best data available to analyze the nature and extent of offset practices[19]. From these documents and from other sources, the following "rough estimates" emerge[20]:

- Military offsets have increasingly become a central factor in awarding military contracts.

Offset is estimated by the U.S. Department of Commerce to account for between 20% and 30% of the roughly $2 trillion of world trade in 1983. However, the U.S. Department of State (INR) believes the total is closer to 15%; the OECD calculates 8%; GATT about 6%; and the IMF 1%[21] [Ref. 2].

The U.S. Government Accounting Office (GAO) found some evidence in the DOD 1983 report that within the five years from that date about $30 billion in

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[18]They were DT/AIA/EIA [Ref. 7], OMB [Ref. 3 and 6], and also some conclusions from Korth [Ref. 1] from other surveys in countertrade realized in 1979 (Carleton University, Ottawa), 1981 (Canadian Commercial Corporation), and 1982 (U.S. International Trade Commission - ITC). This last research data was incorporated into OMB in the interest of reducing the U.S. Government's demands on the private sector.

[19]Data elements include the contract value of sales and the face value of obligations, the value of offset commitments actually fulfilled, years of sales and offset implementation, countries involved, type of offsets, products involved in sales, and U.S. role in sales.

[20]This Neuman expression demonstrates the precarious status of data available [Ref. 2]. The quotation belongs to this author.

[21]See the meaning of the acronyms in Appendix A.

potential U.S. arms sales were expected to involve offsets [Ref. 8]. Recent figures shows that from 1980 to 1987 contracts with offset agreements totaled $34.8 billion and $19.9 billion of obligations associated with these contracts [Ref. 3].

- Offset is applied basically to large capital projects and high technology products.

All surveys indicated a sharply increasing offset requirement in the sale of military hardware, specifically military and large aircraft to recipient countries governments and national airlines[22].

- The prevalent form of offset is direct offset.

The survey respondents reported that over 55% of offset obligations have been in the form of direct coproduction, licensed production, and direct subcontract [Ref. 6:p. 34]. For most of the contracts, the type of offset and method of enforcement were agreed to when the contract was signed, and "best effort" was the most preferred [Ref. 3:p. 8].

- Countries involved in offsets.

Some surveys show an increase in the list of countries involved in offset arrangements. In 1972, only about 15 countries were involved in these arrangements. According to another survey in 1984 there were more than 88 countries that request some form of offset before they agree to buy U.S. exports [Ref. 1:p. 17].

Demand for offsets has come primarily from industrialized countries and 75% of all offset requirements were in countries with high and medium R & D

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[22]DT/AIA/EIA and OMB figures are 74% and 63.9% respectively of total value of sales.

expenditures. For instance, Canada was by far the chief individual country beneficiary of offset commitments both in number of contracts and in value [Ref. 7].

- Characteristics of the Offset Contracts.

The common offset percentage, which is the percentage of contract accounted for by the offset obligations, varied among countries, ranging from roughly 5% to 175% [Ref. 3]. The average time of implementation is 11 years. Of these implementations, a great part refers to indirect offsets.

Most of the supplier companies are still using trade specialists to help facilitate offset. They rely primarily upon in-house specialists or trading subsidiaries, then trading houses or banks and finally foreign government agencies, brokers, and consultants.

- Technology Transfer

Unfortunately none of the surveys were asking about the level of technology embodied because "it would have been difficult to answer and would have discouraged response"[Ref. 7:p. 8].

- The future of the offset agreements.

Some of the reasons given for the continuity of offsets are: the continuing debt problem and shortage of foreign exchange, the general world economic conditions, the need to transfer technology, and economic development needs.

3. Offset Participant Motives

The reasons why any country engages in offset agreements are many and varied. Most of the articles published show that offsets were required by the purchasing governments. On the other side, some evidence shows that offsets have been offered by defense producers as a marketing competition instrument. This subsection addresses the supplier and recipient motivations toward offsets with emphasis in recipient rationale (factors) and gives some international institutions opinions about offset.

a. Offset Supplier Motives

On the supply side, the incentives to export weapons are multiple. They can be grouped in two basic categories: political and economic incentives. As pointed out by Brzoska and Ohlson[23] they operate on three levels: international, national, and industrial [Ref. 9].

At the **international level**, the political factors are shaped by the East-West (U.S and USSR) conflict and the struggle for political and ideological hegemony in the world. However other major suppliers such as France and Sweden are seeing the other face of the coin, showing weapons as an economic commodity.

At the **national level**, other political factors such as to ensure stable employment and provide surge capacity in case of war. The economic rationale at

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[23]Some motivations that drive suppliers in engaging in offset agreements should be inserted in a more general analysis of arms transfers. Brzoska and Ohlson offer an excellent assessment to analyze the structure and dynamics of arms transfers [Ref. 9].

this level is to ensure the stability of civilian markets, the inflow of necessary raw materials, and to improve balance of payments. It is also argued that the longer production runs lower domestic procurement costs and help to recoup some of the outlays on military R & D.

At the **industrial level**, some companies involved directly or indirectly in arms production may share the political incentives. Otherwise, the pressures to export arms are purely economic. The economic incentives at this level are stronger because of three components of weapons market behavior; weapons prices don't seem to fall with the reduced demand; arms exports are a profitable business even in adverse negotiations when the supplier's government guarantees the deal; and arms industries exports account for a substantial part of the turnover, and with the relatively high barriers to entry and exit in arms production this comprises yet another strong and built-in pressure.

As we stated before, this general analysis about suppliers motivations in arms export also gives some directions in which supplier's motivations toward offset may be analyzed. Although the focus of this thesis rests on recipient's motivations[24], a list of specific offset motivations for supplier is

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[24]Some well-known recipient countries are becoming suppliers. Within the limitations proposed for this research, these 180º turns won't be the object of this analysis.

presented[25]. Here are some of the supplier country motivations in offering and accepting offsets:

- The most common supplier motivation is the deal itself. Some managers say that offsets are better than nothing, showing the increasing level of competition from other suppliers;
- For some industries, offsets represent an expansion of market and consequent expansion of product cycle;
- When the firm has a marketable technology, but lacks the resources, offsets represent a way to obtain direct investments or a share in a coproduction agreement; and
- Suppliers that support offsets, and are even using them as a marketing tool claim that such arrangements lower the product unit cost, generate new supplier jobs, and there is no reason to be concerned with the technology transferred, because offsets rarely involve state-of-the-art technology.

b. Offset Recipient Motives

There is a substantial literature that discusses recipient countries' motives for demanding offsets but no effort has been made to catalogue these demands. Although the information available indicates that developing countries are now joining the increasing number of industrialized countries demanding offsets, reasons vary widely [Ref. 6].

Many developing countries are now turning to offset in response to conditions such as: growing debt-servicing burdens, falling commodity prices, generally worsening terms of trade, declining exports and deteriorating domestic economic performance.

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[25]Most of the motivations from this list are seriously questioned by various political and other government officials. They say that these reasons do not justify the jobs lost, the weakening of the defense industrial base, the increasing competition, etc. [Ref. 10].

(1) Offset Factors

As outlined in Chapter One, there are four reasons why recipient countries are demanding offsets[26]. The initial idea is that factors and variables will be rated as high, medium, and low in terms of their contribution to the case.

• **Technological Factors**

Technology transfer is a complex issue because of the numerous variables involved. Problems in developing countries such as lack of political and economic stability, poor absorptive capacity, lack of internal resources to support large projects, inappropriate institutional frameworks and economic policies are only part of the decision-makers' concerns. In addition, concern with the reverse impact of technology transfer has led the supplier countries to impose strict conditions on the recipients [Ref. 11:p. 1].

The variety of factors that influence offset with technology transfer to recipient countries through offset agreements can be grouped into five categories[27]:

Nature of the transferred technology

Various characteristics of **product design** and the relative sophistication of **production techniques** may not be transferred by the supplier firm. This occurs because the supplier firms are less interested in transferring the product fields where substantial R & D funds have been invested or where they hold a technological lead.

Transfer environments

Offsets that involve transfer of technology between different countries are influenced by a variety of **legal constraints** in both supplier and

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[26]The focus is given to developing countries demands because of the case studies analyzed.

[27]The better description of this factor was found in Barason [Ref. 12]. Although his description focused on multinational production, its similarity with the technological factor makes this definition perfectly suitable. The technological integration variable was added to the previous ones established by Baranson.

recipient countries, **stages of product development**, **size of the market**, **government policies of protection**, and **exchange controls**. Another environmental factor particularly important is **competition**. If there is more than one competitor willing to offer offsets, and offsets are a condition of sales, the leverage power of the recipient improves and can bring more quality and quantity of transfer of technology.

Recipient firm's characteristics

In considering whether to enter into an offset arrangement the **technical absorptive capability** of the recipient country and its **potential in competitive markets** are major considerations.

Supplier firm's characteristics

There are two different points of view regarding the supplier country's behavior when transferring technology. First, suppliers often prefer to transfer **technology** to advanced partners because of the ease of transfer coupled with the advantages of cross-licensing. Second, supplier firms are more willing to disclose **technical know-how** to less sophisticated partners in developing countries than to industrially-advanced countries, which may eventually become serious commercial rivals in third markets.

The **transfer capability**, **financial position**, and **corporate philosophy** of the supplier are among factors influencing technology transfer.

Technology integration

The success of an import substitution policy is identified by the capacity of recipient to integrate the technology that is being transferred. There are three ways to measure this variable[28]:

Time is especially important to measure the technology integration of defense industries. These industries are normally constrained by strict schedules. For instance, a missile industry needs to deliver equipment to support the

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[28]These and other ways were suggested by Singh [Ref. 11]. The author identified time, skills, and service sector as the most applicable into the scope of this thesis.

customer's war, and any technology must be integrated faster through an improvement in capital intensive techniques to give greater assurance of delivering the product on time, without sacrificing the quality.

Skills is a measure that indicates if a lack of an adequately trained manpower is responsible for limiting the technology integration. Skills may be analyzed by the period of experience and graduation level of the labor force.

Service sector is the last proposed way of measuring this variable. To have more technology integration, the firm needs to generate more production employment than service employment. It means, if EMBRAER needs to improve technology integration, it should hire more technicians, engineers, and scientists than administrative personnel.

- **Economic Factors**

The offset phenomenon has puzzled economists because it has substituted for the money that allows multilateral trade for bilateral agreements, sometimes without no currency transaction. In Brazil, the development of arms industries has played an important economic and industrial role. This factor argues that some of the developing countries' economic motivations toward offsets may be grouped in four categories:

Conservation of foreign currency

The first idea is that offsets reduce the amount of hard currency needed for defense systems; the same amount of foreign exchange can purchase twice as many units of a defense system if there is a 50% offset [Ref. 6:p. 46]. This linear way of thinking does not mean that offsets save foreign exchange. In these countries, the conservation of foreign currency is a difficult variable to access. A previous study shows that only in rare situations do savings really occur as a balance of one entire offset transaction. As Hennart [Ref. 13] argues, much of the literature has ascribed the growth of offset trade to the heavy indebtedness of an increasingly large number of developing countries. Offset is

seen as a way for these countries to solve their foreign exchange shortage[29]. He continues saying that "a careful analysis shows that the view of using offsets as a way of saving foreign currency generally is not true". He also pointed out one example, "only barter can be shown to have this property, and only under very specific conditions". The other types "consist of separate but linked money-for-goods contracts". Finally, Hennart concludes that with rare exceptions of some barter transactions, the other types of offsets "cannot help countries reduce their outlay of hard currency or improve their ability to borrow foreign exchange"[30] [Ref. 13:p. 130]. This concept is denominated by the author as "**apparent savings**".

With the objective of expanding the concept to better fit measures for the Brazilian cases, the argument posted by the author is the possibility of future savings of hard currency. It means, savings obtained with the future substitution of imports by the internal manufactured of the equipment, assuming perfect transfer of technology[31]. For example, the PIPER case offered some future foreign exchange savings because EMBRAER started producing the planes to attend domestic demand. This new concept will be called from now on "**future savings**".

Another expansion is obtained with what the author of this thesis calls "**opportunity savings**". It means the foreign currency saved in one offset transaction is to be used in other transactions that involve hard currency only. The example is the Brazilian Navy agreement with West Germany to buy two submarines. Brazil paid in ore worth nearly $200 million and saved hard currency

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[29]He also argues that saving on foreign exchange is not the only economic motivation. The article proposes offsets as attempts to build reciprocity in order to reduce transactions costs in the international market for intermediate products, technology, and distribution services.

[30]Hennart did some statistical analysis to confirm the absence of a relationship between indebtedness and two types of offsets (counterpurchase and buy-back) and suggests the reasons for recipient countries engaged in these agreements must be elsewhere.

[31]Sometimes, due to lack of precise data of transactions inside the country, this data becomes hard to access.

for future oil imports, since some OPEC countries only accept cash payments [Ref. 14].

Jobs creation

The developing countries arms industries contribute to a country's social development by industrializing and expanding employment and training opportunities for a skilled indigenous labor force. Although the Brazilian government's economic policies have never induced nor led to the realization of specific employment goals[32], this variable measures the employment benefits from one offset transaction. There are four different approaches of this benefit.

First, the creation of jobs is real. It means, certain new coproduction or licensing production is requiring a certain number of new employees with general knowledge and offering system-specific knowledge or firm-specific knowledge[33]. This is called **real employment benefits**. Second, sometimes this gain in employment in the so called "high-tech" industries occurs at the expense of employment in the industries in which Brazil has a comparative advantage, thereby reducing its real output and income (e.g., some employees shift from automotive industry to EMBRAER [Ref. 6:p. 40]. This is called **apparent employment benefits**. Third, the creation of jobs can be indirect. It means that other jobs are created as consequence of the offset agreement. The example given is the expansion of airlines crew and administrative people in consequence of the acquisition of civilian aircraft to incorporate in its fleet. The offset agreement (e.g., counterpurchase of other merchandise) is indirectly creating new jobs. This assessment is called **indirect employment benefits**. The last job creation measure is called **support employment benefits**. This assessment considers as creation of jobs the capacity that the offset agreement offers in maintaining the

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[32]In Brazil there is no definitive orientation with respect to technology choice and employment level in the manufacturing industry [Ref. 15:p. 4]. The majority of the Brazilian government incentives to stimulate industrial growth have been to lower the capital costs (machine) and in consequence, make the capital-intensive firm more viable than labor-intensive firms.

[33]See definitions in Technology concept subsection.

recipient's labor force's qualitative and quantitative capability to produce. Scientists, engineers, and technicians need constant improvement in technology training and new challenges.

Expand exports and imports

Some recipient countries state that offsets are a way of getting new markets for their products and overcoming the barriers to expanding imports. These two possible recipient motivations in using offsets were identified and will be measured as follows: First, offsets may offer a way to expand export. This is obtained by the recipient using the suppliers' **marketing expertise** and **distribution network** to open new markets for their products [Ref. 2:p. 193 and 16:p. 170]. These products may be current merchandise or excess production capabilities [Ref. 17]. Second, offsets provide to the recipient countries, who are concerned to somehow get around the constraint on development imposed by a shortage of hard currency, an opportunity to raise imports level above where they would otherwise have been [Ref. 16:p. 164]. This is done in three ways: as a means of undercutting prices and quotas set by **International commodity agreements**, a method of concealing the **dumping**[34] of surplus goods, and a means of **circumventing International Monetary Fund** (IMF) restrictions on recipient's imports [Ref. 2:p. 193 and 4]. Therefore, an offset may be measured by its capacity to contribute to improving both export and import.

Enhance Financial Viability

A decline in arms sales to Third World after 1982 probably reflects more a decline in these countries' abilities to finance new purchases than a decline in real demand [Ref. 18:p. 171][35]. As Neuman argues, "disturbances in the international economy since 1973 - rising oil prices, high rates of inflation, and

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[34]See a discussion about the dumping effect in Banks [Ref. 16:p. 170].

[35]One interesting empirical study by Steve Chan suggests that much of the demand for arms by the Third World was from those countries that were also net importers of oil [Ref. 19].

slow economic growth and trade in many countries - have produced large trade deficits, particularly among the non-oil producing LDCs".

Obtaining financing for some countries has been one important reason to engage in offsets. Offsets allow a recipient country with high external debts, liquidity constraints, and exchange controls to continue trading even when hard currency is not available [Ref. 5]. Offsets do not increase overall indebtedness, requiring only interim financing for the period between import and export. The question arises as to whether offsets could result in an expandable supply of credit beyond that available under normal trade. Three different assessments were found to explain and measure this variable. First, a financing offset involves **standard methods of financing** such as government-supported credit programs, bank to bank credit lines (letter of credit), and buyer and supplier credits. Second, although commercial banks generally do not lend money to finance such double-edged transactions, some offsets that generate increasing the volume of exports are considered as guarantees. In this case, the offset agreement allows a **deferral payment** until a specific time in the future or for spreading out of payment over a prearranged period. The last assessment is when some offset agreements bring some kind of **foreign direct investments**.

- **Socio-political Factors**

The international arms trade market is governed more by the objectives and policies of recipient governments than by traditionally defined market influences. This variable measures the internal political feasibility of an offset agreement.

Political motivation

The political acceptability of arms purchases from a foreign source is one of the factors in the development of weapons procurement policies of recipient countries [Ref. 6]. Offsets may be smartly used as internal political tools to justify large military hardware purchases to constituents. With offsets it becomes easy to say "don't worry, we will get it all back". This variable expresses the level of different internal government organizations influence on the process. In Brazil, despite the austerity policies demanded by Brazil's crisis, the arms

industry seems not to be affected or affected very little. One hypothesis directly related to this fact is that the development of an arms industry shifts the military to a more international political role (not as belligerent country, but as a supplier of training and equipment) which may allow the military to withdraw from domestic politics [Ref. 20:p. 74]. Exemplifying the military political motivation, in mid-1980s, was the Brazilian armed forces establishing the National Aerospace Defense System, a project that sent the Chief of Staff of the Armed Forces (EMFA) to West Germany in search state-of-the-art computers. Reflecting Brazilian commitments, the government agreed to accord the data processing sector a high priority in the allocation of scarce dollars [Ref. 21:p. 341].

Government action

The direct role of the recipient governments in oversight of offset agreements has increased dramatically[36]. Particularly in developing countries this role has been fundamental in the process of industrialization. There are three ways that recipient governments may act in the offset process. They may act as a negotiator, supporter, or comptroller.

Using various forms of leverage, recipient countries may be active or an observer during offset negotiations. As an **active negotiator**, the government increases the recipient firm's leverage towards supplier obligations, labor unions, and others government agencies directly or indirectly involved. As an **observer negotiator**, the government may share the expertise and experience in negotiations, provide facilities and manpower in an Embassy, and help in legal aspects.

The government support exercises considerable influence over offset agreements. Some types of support include Government Furnished Equipment (GFE), transportation using military aircraft, test and training facilities, and tariff incentives.

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[36]The OMB report indicates an increasing foreign government intervention. In a survey, the respondents pointed that the foreign government acted as a sole negotiator in over 75% of all offset agreements.

Recipient governments have various reasons to control the offsets' fulfillment. Their concerns vary from trade control (export and import licenses, tariffs, quotas, etc.) to technology transfer control (quality assurance, technology choice, etc.).

Political and social pressures

The political and social pressures variable represents the level of influence of the people of the nation and its institutions such as military, technocrats, congress, industry, press and labor unions. In Brazil, the **military** has taken the leading role primarily on issues relating to security. The success of the Brazilian arms industry, where most companies belong to the state, gives the military ministries total power in negotiating the acquisition and consequent offset agreements. In the case of the aerospace industry the Aeronautics Ministry is responsible for approving all major projects. The **technocrats** include some ministries and some officials that work in the state-owned banks. Sometimes they are involved in offsets but usually only by providing financing expertise due to their international trade experience. In the **industry**, the influence of manufacturers in the offset decision-making process is fundamental, where their entrepreneurial, technical and marketing experiences are the major contributions. **Congress** has played a marginal role in deciding about offset agreements. Since 1964 until now the Congress has been isolated from the process of decision that involves the Brazilian arms industries. The Brazilian **press** has been just a channel of publication of commercial and technological success reached through offsets, but its influence seems to be a bias toward pro-national industry. For similar reasons as the Congress, **labor unions** have been far away from the offset decisions. With the ascendence of the Workers Party, Partido dos Trabalhadores (PT), perhaps this sector will exercise more influence. Most of Brazil's **population** has been absent from the offset analysis because they are absent from the industrialization decision-making process[37].

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[37]An excellent discussion about the decision-makers is found in Tollefson [Ref. 22]. Most of the information of this section was extracted from his thesis.

- **Military Factors**

The military factor has a set of variables that exercises fundamental weight during negotiations of military offsets. This factor is somewhat more intense in countries such as Brazil, where the military seized power and governs the country. Due to the abstract level of the following variables, it was necessary to establish some examples to clarify the concepts.

Industrial Defense

The improvement and preservation of indigenous arms production capability has been considered essential for maintaining Brazil's national security. The great interest of Brazil's Aeronautics Ministry is centered in three new areas of technology that are developing in large projects. These areas are: (1) computer engineering for projects of atmosphere-escaping airspace vehicles (2) material science and engineering (resistance composites); and (3) airspace engineering and science, that is propulsion energy conversion, instrumentation and control of vehicles and systems, and airspace structures [Ref. 23]. With these technologies, the Brazilian arms industries will become more powerful and competitively prepared. This very abstract variable measures the potential benefit that the transfer of these or other competitive technologies brings to overall aerospace industry.

International prestige

As developing countries' indigenous arms industries reach certain technological capability, they become more and more politically independent. This new "political power" is called international prestige. This variable is seen when a foreign country psychologically perceives this "power" when Brazil is involved in offsets. Although it may seem too abstract, this variable may be measured by the future arms exports which originate with the production of a weapon made possible by technology obtained through an offset agreement.

Military Capability

One of the hypotheses about offsets is that they provide an increase in the number of units that certain countries may afford, contributing to improve their military capability. In the case of Brazil sometimes this is not

applicable. Although the Brazilian industries are producing most of the weapons actually used by the Armed Forces, the services have not increased their stockpiles in the same proportion. Instead, it is developing the productive capability and technology to have weapons readily available whenever necessary [Ref. 20:p. 73]. As a result, almost 90% of the production is destined for export and only a small part is really absorbed nationally. In the aerospace sector, even with an increasingly indigenous production of aircraft and missiles, the Air Force seems to be the most technological dependent service in relation to "high-tech" weapons. This variable measures the offset potential in improving the military capability. Each case will be analyzed as to the real contribution made to increased quality and quantity in the service arsenals, and not only the industrial capability. One lesson from Malvinas war gives an example of how this variable operates. The Brazilian Navy, impressed with the Exocet, not only pressed ahead with plans to build an antimissile cannon, but also opened negotiations abroad to purchase Exocets or similar missiles[38].

Independence and Non-vulnerability

During recent years some developing countries have been insistent upon increased transfers of technology in order to expand their manufacturing capacity and reduce their dependence on foreign military equipment. This variable measures the capacity of a recipient country to prevent an embargo or other supplier attempts to restrict the type and quantity of arms needed. Although none of the developing countries pretends to be totally independent, their objective is to increase their bargaining leverage in acquiring the weapons they need in the time, quality, and quantity wanted. Often the recipient countries come to depend on package deals of spare parts, thereby making it difficult to switch to alternative sources in time of conflict, especially if they are relying on a single source of supply [Ref. 18:p. 168]. Another indirect approach in

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[38]At this time, military research activities emphasized the development of various types of missiles. SM-70 Barracuda, an anti-ship missile, is one of the projects developed by AVIBRAS. See Chapter Four for more information.

which offset exercises a major role is when Brazil exports arms to oil supplying countries in exchange for petroleum, a rather important Brazilian vulnerability. Brazil has presented one example of the importance of this variable, when it established an autonomous military-industrial capacity, encouraged by successful arms exports. The long standing administration campaign has been to nationalize war material.

(2) Offset Outcome

For this thesis, the three possible offset outcomes are considered as the dependent variables for the Brazilian offset cases[39]. They are presented below with some more detailed explanation. Each outcome will be rated as high, medium, and low in terms of offset contribution to the overall benefit.

- **Independent technological capability**

This dependent variable, as an offset outcome, emphasizes not a country's possession of advanced weaponry acquired from developed countries, but the capacity to produce and sell it competitively. Not only the technological capacity transferred through offsets is considered but also sufficient R & D capability to keep aerospace products at a competitive technological quality. Therefore, this variable argues that aerospace products and technology obtained through offsets allied with indigenous R & D will result in new products and technologies which may find uses in other industries.

The result of the spread of military technology to date has been to create a hierarchy of states defined in terms of their capabilities [Ref. 25]. The range varies from those capable of producing the whole spectrum of modern weapons and those only with capacity to produce small conventional arms. Brazil is considered at the middle range with some ambitions objectives in establishing foundations for a broadly-based arms industry. A major component of Brazil's strategy is the acquisition of technological know-how. Eventual independence in arms acquisition can only be achieved by gaining direct physical control and knowledge of the

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[39]These outcome variables were suggested originally by Moxon, et al. [Ref. 24:p. 205].

production process [Ref. 20:p. 80]. The cases will indicate if the wanted objective (independent technological capability) is really obtained with the offset agreement. The hypothesis of this thesis is that this outcome is the main objective that motivates Brazil toward offsets. One vigorous example of the importance of this variable as an outcome is found in the high priority given to establishing a national computer industry by the Brazilian government[40].

- **National security capability**

The national security concept in Brazil has been a constant function of threat perception. Since the Brazilian military seized power in 1964 these concepts have changed as the military definition of the mission changed. In the period between 1964-74 the two major objectives of the national security doctrine were **security** and **development** ("Segurança e Desenvolvimento"). However, in 1974, when General Geisel became the president, the instruction changed to "less security and more development". It meant less internal repression and more long term investment in development. This phase inaugurated a period called "abertura", which has moved the country toward a redemocratization [Ref. 20]. Before 1974, the mission was "promoting rapid economic development and simultaneously waging relentless war on the radical left", which was perceived as the primary threat [Ref. 21]. This concept of internal security was held by successive military administrations during the 1967-74 period when the subversion and "indirect communist aggression" was the most likely conflict scenario for Brazil. Since the early 1970s, three strategic images assumed critical importance for the Brazilian military shift to an external threat perception. They were the confrontation dimension of relations with Argentina, the globalization of Soviet military, and the technological revolution in warfare. Some facts such as the Vietnam war, Soviet intervention in Cuba and Angola, and the Malvinas war gave the Brazilian military

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[40]President Figueiredo's administration in 1979 set up the Special Secretary of Informatics, Secretaria Especial de Informatica (SEI), to supervise the computer-manufacturing sector; an army colonel headed the new agency, which was placed under direction of the National Security Council.

the evidence of failure on national defense concept that was based on "trusting in the protection of allied powers". Suddenly Brazil discovered that it was alone.

These constant changes in the Brazilian military threat perception and military mission as a consequence have been one of the major incentives for Brazilian government improved aerospace and nuclear technologies, weapons modernization, and military personnel and organizations. President Figueiredo emphasized these in a December 1984 speech.

> National defense calls for the top efficiency, and top efficiency can be achieved only with full time dedication by those who are in charge of it, with constant training, and with the mastery of technology [Ref. 21].

The offset case outcomes will be analyzed as to their contribution to improved national defense capability. One example of this concern in improved national defense capability was in the mid-1970s, when Brazil and Germany concluded a pact providing for complete transfer of nuclear technology to Brazil. That agreement came just after widespread speculation over Argentina's nuclear intentions [Ref. 20:p. 78].

- **Economic Capability**

Offsets fit into the increasingly prevalent ideology of bilaterism that characterizes developing countries policy, calling for balanced trade on a country by country basis [Ref. 5:p. 27]. This ideology may provide to public administrators of these countries incentives to enter into formal bilateral-balancing arrangements and offsets for balancing the payments. Balance of payments represents one of main Brazil's main economic necessities[41]. The obvious danger in this trend is that

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[41]Brazil's foreign debt of $120 billion and how and whether to pay is the most pressing issue polarizing that country.

it diminishes the potential of hard currency earnings of countries like Brazil, which are already hard pressed to meet their debt-service commitments[42]. The economic capacity is an important variable to measure the impact of aerospace products exports and imports savings. The outcome expected under this title is an offset agreement really contributing to improving the balance of payments. One example of the success of this outcome has been the increasing sales of the Brazilian designed trainer, Tucano, to various countries.

c. Institutional Opinions[43]

Some international institutions are concerned with the increase of offset practice around the world. Specifically GATT, IMF and OECD opinions are described below.

The **GATT** general agreement's fundamental objection to offset agreements is that they undermine GATT's basic principles of nondiscrimination and general prohibition of quantitative restrictions. It means that the general agreement restricts bilateral arrangements between an importing and an exporting country, and prohibits all measures, including quotas and import-export licenses, that would restrict commercial flows between trading partners. While offsets may not be illegal according to the wording of the GATT articles, their consequences flout the spirit of the open, market-driven, and multilateral trading system which is the basic reason for the general agreement's existence.

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[42]Brazil is spending roughly 80% of its export earnings to service its foreign debt.

[43]Most of the information about institutional opinions was extracted from Verzariu [Ref. 26] and BIC [Ref. 5].

The **IMF**'s policy has resulted in consistent pressure by the Fund on its members to reduce reliance on bilateral payment agreements. The IMF's particular concern with offsets refers to potential restrictions by such practices on payments and transfers for international transactions. These include impositions of offsets, penalties or other costs, and blocking payments. It could be argued that by conditioning indebted countries' balance-of-payments and trade in parity (i.e., by enhancing exports and reducing imports), the IMF itself fosters offset initiatives intended by these countries to achieve such a goal.

OECD has been opposed on economic and trade-policy grounds to mandatory east-west offset arrangements. The issue of east-west offset has resulted in numerous OECD studies[44].

B. TECHNOLOGY TRANSFER CONCEPT

Technology transfer in the modern world is a complex phenomenon that may be examined from a variety of perspectives. This section emphasizes the technology transfer related to offsets.

1. Technology and Technology Transfer Concepts

Any discussion involving technology transfer must start with clear concepts of technology. Without such concepts, the interrelationship between technology and its dynamic movement cannot be fully understood.

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[44]For an example of East-West discussion, see OECD [Ref. 27] and Murrell [Ref. 28].

a. *Technology Concept*

The term technology has its origin from the Greek word "techne" which means an art or skill. Technology is defined most simply as knowledge. More elaborately, technology is "any tool or technique, product or process, physical equipment or method of doing or making, by which human capability is extended" [Ref. 29]. This definition indicates clearly that technology is both hardware, consisting of such elements as factories, equipment, infrastructure, software, or the nonmaterial components of the productive process, such as education, experience, and organization. Knowledge required to use the hardware to produce goods or services is an essential element of technology [Ref. 30]. This thesis rests upon a definition of technology that categorizes it in terms of types of knowledge that are outlined below[45] [Ref. 35]:

- **General knowledge** refers to information common to an industry, profession, or trade. At one extreme this category includes such basic skills as arithmetic, and at the other such specialized skills as blueprint reading, tool design, and computer programming.

- **System-specific knowledge** refers to the information possessed by a firm or individuals within a firm that differentiates each from its rival and gives a firm its competitive edge. Some of this specific information will have been acquired through engaging in certain tasks or projects. It comprises ingenious procedures connected with a particular system, solutions to unique problems or requirements, and experiences unlike those encountered with other systems. System-specific knowledge is when a firm, in manufacturing an item, acquires information that is peculiar to that item. Were any other firm to manufacture that item, it too would probably obtain the same technology.

- **Firm-specific knowledge** differs from system-specific knowledge in that it cannot be attributed to any specific item the firm produces. Firm-specific knowledge results from the firm's overall activities. Some organizations possess technical knowledge that goes beyond the general information

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[45]These categories are chosen because of the close application in aerospace.

possessed by the industry as a whole; another firm manufacturing the same products would not necessarily acquire this same technology.

To illustrate the differences among the three types of knowledge, some information required for the manufacture of the F-5 aircraft is common to all firms with an aircraft manufacturing capability; this is **general knowledge**. The particular firm that manufactures the F-5 has acquired some specific information about this weapon system not possessed by other firms; this is **system-specific knowledge**. Certain other technology is possessed by this producer that other firms do not share, but which is not attributable to the F-5; this is the producer's **firm-specific knowledge**.

b. Technology Transfer Concept

A precise definition of technology transfer is somewhat difficult to obtain. The following are some definitions:

> "The process in which an innovation originating in one institution is adopted elsewhere" [Ref. 31:p. 31].

> "The simple act of obtaining information from external sources-in order that it may speed up industrial development and at the same time conserve its technical resources" [Ref. 32:p. 21].

> "Technology Transfer is the process of transferring, from the industry in one country to another or between countries, technical information relating to the design, engineering, manufacturing and production techniques for hardware systems using recorded or documented information of a scientific or technical nature. It normally does not include the transfer of common reference documentation such as military standards, specifications, handbooks or commercial counterparts to these documents" [Ref. 30].

Any definition of technology transfer will not be complete, without the identification of the types of transfer[46]:

- **Single Track**: the use of an item of superior technology in a established slot in a going operation, with the transfer being accomplished without modification.

- **New Track**: plugging the new technology into a whole new activity established as a consequence of the transfer.

- **Cross Track**: transfer of the new technology to an activity or use for which it was not originally designed. In cross track transfer, therefore, technology must be adapted to a different set of conditions and purposes than for which it was designed.

- **Vertical Transfer**: an innovation is adopted within a social system or institution -such as a nation, scientific discipline, corporation, or a government agency. In the other words, it is the adoption of an innovation "through ministries and other change agencies to firms".

- **Horizontal Transfer**: an innovation is adapted to a different application, across system or institutional lines, or from country to country.

- **Unplanned Transfer**: a chance phenomenon - lack of premeditation on the part of the transferor or the transferee - takes place. In the absence of systematic and purposeful work, such a transfer goes relatively unnoticed during the process.

- **Planned Transfer**: modern systematic acquisition and purposeful use of foreign-developed technology for promoting technological change and economic development. As opposed to the unplanned type, planned transfer of technology is not the result of chance or accident.

The case studies analyzed deal with offset agreements that include planned technology which theoretically benefits both the transferor and the transferee, with special emphasis on the latter. In this thesis, transfer of technology occurs when technology is transmitted, received, and applied.

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[46]The identification of types was extracted from Singh [Ref. 11:p. 8].

2. Technology and Trade

Technical knowledge has become an important item of international trade. However, changes toward greater restriction in some developing countries and less in others make the current international environment very turbulent. This subsection addresses some developing countries' general orientations toward foreign technology[47].

Wallender stated that, prior to 1965, the developing countries focused on general improvements in their GNP through both import substitution and export promotion. However, at the same period, even with some countries showing positive real GNP growth, they felt an "increasing sense of dependency" on the developed countries for technologies and capital. A "new economic order" was needed[48].

Since the early 1970s various developing countries have been involved in intergovernmental debates, exposing their direction and underlying strategies towards development. Success of the OPEC cartel and the creation of the United Nations (U.N.) organization specifically to cope with third world problems (the U.N. Conference on Trade and Development - UNCTAD) helped the formation of a Third World bloc[49].

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[47]Most of this discussion came from Wallender [Ref. 33].

[48]The term New International Economic Order (NIEO) represented the prevalent idea in 1970s among third world countries. In part, it means an improvement of third world countries power related to the transfer of technology to their countries.

[49]The UNCTAD group started with 77 countries and by the late 1960's it had grown to 115 countries, when they establishing a formal declaration which demanded the creation of a New International Economic Order.

One of the principal objectives of this program was to increase the bargaining power of the third world countries and to gain greater control over multinational firms and how they transfer technology and capital to their countries. Some specific objectives included:

- Reducing the social and economic costs of technology acquisition in the Third World;
- Increasing the power of the third world governments and their productive sectors in terms of choosing and acquiring appropriate technology;
- Establishing new institutions that would help governments take a more active role in controlling and directing the technology and capital flows;
- Establishing means through which technology and capital could be more efficiently diffused within the host (recipient) country after its initial transfer;
- Creating pressures to establish more research and development in the developing countries; and
- Carrying out studies and programs that would help design model laws and institutions that will force multinational firms into joint ventures with local governments and local private sectors.

As a result of these programs, debates, and research projects, the new power of the third world was established. By 1974, over 20 countries had enacted specific legislation and created specific office's to control and direct foreign capital and technology[50]. The offices actions and regulations focused on lowering the royalties paid for technology, forcing local participation in management and ownership, and increasing the government capability to screen and direct foreign activities within the nation. Most of the regulations were aimed primarily at protecting the nation from balance of payments impacts associated with

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[50]At this time, the National Institute of Industrial Property (INPI) was created in Brazil. Some of its functions will be discussed in the next chapter.

technology transfer. Some countries including Brazil also began to stress joint ventures and proscribed foreign participation in a variety of industries.

By the mid 1970s the more restrictive policies were reversed in a number of countries. Some governments believed that certain nationalization programs had gone too far in restricting foreign participation. A new orientation came and seems to continue up to now. It is expressed by:

- Reducing the opportunity for 100% owned foreign ventures;

  . increasing local orientation toward self help and internal development of science and technology with less foreign assistance;

  . an interest in acquiring and diversifying sources of foreign technology;

  . a focus on building local institutions for stimulating local science and technology development rather than relying on free market practices; and

  . concern with geographically and demographically spreading the benefits of industrialization and technology transfer.

In summary, Third World countries concerned with their dependency status formed a block to establish a New International Economic Order that regulates the transfer of technology from developed countries. This background will be important to understand some of the regulations existing in Brazil concerned with the transfer of technology, license agreements, and joint ventures. Although in some countries these regulations are not applied to acquisition of military

equipment or aircraft, some of the basic principles are intrinsically considered for offset agreements.

3. The Application of Military Technology in Commercial Business[51]

Civil and military aerospace technology have shared the same airspace and have lived in a symbiotic relationship, while each responds to its own set of specifications. The close links between civil and military aerospace technology raise a number of interesting questions about the application of military technology in civil aviation or space-related activities. How is military technology transferred to a civilian application? What kind of technology is being transferred? What's the Government role in this aspect? This subsection concentrates on defining the "spin-off" phenomenon and identifying some aspects of the contribution of this phenomenon for an improvement of the recipient's choice of aerospace technology transferred.

It must be clear that the objective here is not to conclude that this phenomenon, most of the time underestimated in offset negotiations that involve technology transfer, should be given total priority in developing countries decision-making. The intention is to show some benefits of developed countries' experiences in sharing military technology with commercial business[52].

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[51]Most of the material for this discussion was extracted from Wells and Waterman [Ref. 34]. Although they focus on space spinoffs, the discussion may be applied to aerospace industry in general.

[52]The secrecy of developing countries's sensitive military projects poses tremendous obstacles to the transfer of technology from military research to the private sector.

Opinion is sharply divided on the value of aerospace technology to the commercial economy. Aerospace enthusiasts exalt the benefits of "spin-offs" from missile, space and aircraft programs. Skeptics points to errors in these claims and maintain that "spin-off" benefits have been and will be relatively minor.

Who is right? An answer is important to justify a representative part of developing nations' resources committed to government military programs, primarily to develop and produce military weapons as aircraft, missiles, and rockets. Most people agree that such expenditures are essential to national security and certain preeminence in air security. Most also agree that commercial investments are essential for growth in the private sector. Therefore, it is reasonable that the resources committed to aerospace programs should serve a dual purpose by encouraging the transfer of the technology to commercial use wherever possible [Ref. 34].

Spin-off is the phenomenon of technology transfer of military technology to commercial purposes. It can be classified as **tangible**, using well defined products, processes, or materials originally developed for military application, and **intangible**, using the military scientific technology information. Intangible spin-offs are far more important and can contribute to the invention of an entirely new product, process, or material (e.g., plasma-jet). However, tangible spin-offs are easier to identify and can act to make something more available or to reduce the production cost (e.g., solar cell)[53].

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[53]This author argues that tangible spin-offs may be decreasing as the weapons become more and more complex, and open a "technological gap" between military and civilian technology.

The aerospace technologies commonly involved in this phenomenon are grouped in the following areas: instrumentation, electronic components and miscellaneous systems, control systems, power sources, propulsion, materials, medical technology, telemetry and communications, packaging and shipping, and management and control [Ref. 34].

The government role in fostering this process is fundamental since often it is the only entity that can afford the major cost of such military programs. Its action should be related to centralizing the planning and direction of technology and support programs that improve close relationship between defense industries and other civilian producers.

In summary, the spin-off phenomenon and its importance and benefits are not well known even in developed countries. Spin-offs alone should not be used to justify large military programs. But given other needs, spin-offs can be included as an important issue in the future recipient's choice of technology embodied in offset agreements.

III - GOVERNMENT OFFSET POLICIES

There are two different views about offsets. The recipients' view is that offsets are an integral part of the sale itself rather than unrelated "compensation practices". The opposite, suppliers' view is that offsets improve the overall value of the sale. These conflicting views are useful in understanding how governments establish bipolar offset policies.

The increasing use of offsets has motivated a lot of countries to set policies. This chapter addresses some supplier and recipient offset policies, and includes an overview of the Brazilian offset policy, with focus on the Aeronautics Ministry offset policy.

A. SUPPLIER COUNTRY OFFSET POLICY

Supplier governments have difficulty in establishing an offset policy because of competing group interests. Offsets for some defense industries are a nightmare that seems to never end. For others, they are a very efficient way of getting business. Further complicating the setting of policy is the fact that it is very difficult to distinguish which industries have been successful in applying offsets as a marketing tool, because they don't like to share the good or bad experiences with other competitors. This subsection clarifies these issues by explaining the offset policy of the United States.

1. The U.S Government Offset Policy

According to the GAO, the U.S. has no comprehensive national policy on the administration of offsets, there is little coordination among the agencies studying offsets, no central data base exists on offset commitments, and complete and accurate data on offsets are not otherwise readily available [Ref. 1:p. 9].

Although officials at the Office of Trade Representative generally agree that such a policy is needed, they have not agreed on how it should be administered and which agency should have the lead role.

Since 1978, the nearest statement of policy has been the Department of Defense (DOD) memorandum (called the Duncan Memorandum) stating that: (1) DOD will stay at arm's length in guaranteeing offsets unless industry is unable to satisfy a foreign government's demand; and (2) FMS credits will not be used to directly finance coproduction or licensed production abroad[54] [Ref. 2].

Prior to 1978, DOD negotiated equipment acquisitions which included offset arrangements between U.S. defense equipment manufacturers and other countries. However, after the Duncan Memorandum, DOD policy changed so that DOD would not be involved in negotiating such arrangements unless they could not be resolved otherwise. As a result, offsets are now negotiated directly between the U.S. defense contractor and the procuring government, usually without DOD commitments and involvement [Ref. 1].

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[54]The more important exception of this rule was Israel's Lavi fighter project where $200 million in FMS credits were approved for Phase I of the program. Later, even the U.S. Congress considered the Israel situation as a precedent. For more information of FMS assistance to Israel see U.S. Assistance to the State of Israel, GAO/ID 83-51, 24 June 1983.

The U.S. has been taking no active role in administering offset transactions and therefore no agency comprehensively monitors offset activity. Coordination of the administration of offsets, to the limited extent it exists, does not involve departments such as Treasury and Commerce, which have major trade policy interests in these transactions.

Reasons for adopting the existing policy included (1) the management complexities and resource drain on DOD in negotiating and implementing offset agreements; (2) such agreements had the effect, or created the impression, of obligating the U.S. government to place orders for systems or components in foreign countries or requiring DOD to force U.S. contractors to do so; (3) a conviction that offset commitments were business judgements which should not involve DOD; and (4) once commitments were made by industry, the U.S. defense contractors, not DOD, should assume responsibility to the foreign government for fulfilling the promised offset.

In March 1980, DOD restatement of this policy specifically asked NATO to continue to rely on industry to arrange for efficient means of arms collaboration on each sale. If industry is unable to satisfy any particular government's demands, then government-to-government agreements involving offset may be considered. At that time, as government officials said, there was no involvement concerning technology transfer, impact on the U.S. industrial base, and other political, economic and military concerns [Ref. 1].

This DOD policy is currently being reevaluated [Ref. 1]. Congressional pressure resulted in the 1989 Defense Authorization Act, which requires the

Secretary of Defense to consider the impact of a potential offset on the defense industrial base, and solicits the views and recommendations of the Secretary of Commerce prior to conclusion of any agreement relating to R & D and procurement of foreign defense equipment [Ref. 3]. The first evidence of this policy change was the U.S. and Korea agreement in relation to the Korean Fighter Program (KFP). Korea was considering purchasing 120 aircraft, either McDonnell Douglas F/A-18 Hornet or the General Dynamics F-16 Falcon. The sale was estimated to be worth $2.5 billion and the Koreans asked for 100% offset in licensed production, indirect offsets, and coproduction. The Secretary of Defense stated a ceiling of 30%, reflecting a radical change in U.S. government policy [Ref. 4 and 5].

As stated before, the U.S. Department of Commerce and the Treasury have interests in these transactions since they administer credit and licensing arrangements but are rarely consulted during DOD's review of U.S. defense contractor compensation agreements. In military offsets, DOD has negotiated and implemented them with little or no input from other agencies[55] [Ref. 1].

Some U.S. industry and agency officials believe that offset demands will accelerate if the new administration doesn't react. Although in the case above this policy seems appropriate, they continue to be concerned with the competition and consequent loss of sales by U.S. industries. As they said before, they think that the

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[55]Very similar problems occur in the Brazilian government, where the trade department and other agencies have not been active in the export of Brazilian-made arms and technology [Ref. 1].

U.S. government should negotiate multilateral agreements, instead of taking a unilateral position to remove offsets from military sales.

B. RECIPIENT COUNTRY OFFSET POLICY

Recipient governments have established a wide variety of specific offset policies. They depend on previous experience with negotiating offsets, national objectives and interests, and the perception of the benefits gained from offsets.

The recipient country normally starts its offset policy through indirect offsets (short-term policy) and then puts emphasis on direct offsets (long-term policy). The latter type brings long term benefits, creating an industry and manufacturing plant [Ref. 6].

> Customer demands for offsets stem by-and-large not from the defense industries of the recipient countries but directly from their governments. Purchasing countries generally administer these programs through their defense or economics ministries; sometimes there is interagency group set up to administrative offset contracts [Ref. 7].

In this subsection, three examples of different offset policies from different countries levels are presented with different objectives in mind. Although they present some differences, some similarities are perceived such as their interest in competitive technology, maintenance of employment, and savings of hard currency.

1. British Offset Policy[56]

The most recent large offset agreement involved the sale of the Boeing E-3A AWACS system to U.K. and France. The AWACS deal with the U.K. involves

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[56]All this information was extracted from Clifton [Ref. 8].

seven aircraft worth more than $1.5 billion in 1986 dollars and a huge offset of 130% offered by Boeing, to be fulfilled over eight years.

Offsets are a British Ministry of Defense (MoD) requirement if the deal meets MoD criteria. Current procurement policies of the MoD are guided by two basic and simple but profound principles: value for money and competition in the marketplace. These principles direct the following objectives and policies:

- Any offset figure or percentage is specified, but ideally seeks 100% of the full contract value;
- The major objective of offset requirements is to expand and strengthen the British high technology industrial base;
- A large proportion of the work should be high technology, to develop the capability of U.K. companies in new technologies or new techniques;
- The period for implementation should be as short as possible at least within the delivery time for the deal that triggered the offset;
- All offset orders are to be competitive; open competition that returns best overall value for money to the MoD;
- The offset agreement is evaluated twice yearly by Defense Export Services Organization (DESO) through reports submitted by the supplier; and
- Previous contracts awarded receive offset credit.

2. Australian Government Offset Program[57]

It is a firm requirement of the Australian government that offsets be directed back to the Australian manufacturing industry by an overseas supplier who receives a major order for equipment and services.

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[57]Most of the information was extracted from Business International Corporation [Ref. 9].

The offsets program is part of the general policy for development of a more specialized, efficient export competitive manufacturing industry. It seeks to secure a workload which will broaden the capabilities of the industries that are of technological or defense significance to Australia and stimulate technological advancement. It also aims to provide new employment opportunities within Australian industry.

The policy applies to all Commonwealth departments and authorities for all types of contracts for goods and services and in any area where there is government involvement in purchase decisions. Here are some criteria for application of offset policy and procedures:

- The value of offset required in each instance is at least 30% of the net tender price (i.e., excluding the value of Australian content not covered by the offsets proposal offered as part of the tender);
- All contracts for purchase or lease valued at $1 million or more with a minimum of a $500,000 imported content come within the scope of the offsets policy;
- The government offsets authority, in conjunction with the demanding authority, is responsible for determining the technical nature and scope of an acceptable offsets arrangement and providing advice regarding the acceptability of offset offers to the purchasing authority;
- Once an offsets proposal or commitment has been approved by the Interdepartmental Committee on Offsets (IDC Offsets), or the Offsets section, as appropriate, the purchasing authority will be advised accordingly. No contract can be entered into with any tendered unless their offsets proposal has been accepted; and
- Offsets achievements in excess of the contracted figure will be recorded and may be applied as credit against future government purchases.

3. Indonesia Countertrade Experience[58]

Indonesia was the first country to develop a countertrade policy in Asia in the late 1970s. Indonesia chose a countertrade policy over other economic tactics -- such as reducing imports or cutting back on development plans -- in order to meet economic and political pressures that were facing the government in late 1981. In January 1982, the Ministry of Trade formally promulgated "guidelines for the implementation of linking government import procurement with Indonesian non-petroleum exports". Since then Indonesia has rapidly acquired a reputation as a country with one of the world's most stringent countertrade policies. As a result, selling to the country's public sector has become very difficult for foreign firms that are not in a position to find markets for the limited range of countertrade products.

The countertrade policy provided for the following:

- Procurement in excess of 500 million rupiah (about $500,000), financed from State Budget or export credits, must be linked to exports. This applies to procurement by Departments, Non-Departmental Government Institutions, and State-owned enterprises;

- The Department of Trade and Cooperatives will periodically issue a list of eligible export[59] products and a list of exporters and commodity associations. Foreign suppliers may chose one or several goods from the list;

- The value of Indonesian exports must equal the value of government procurement (100% linkage). The value of the contract for the government is to be stated on an F.O.B. basis. The price used in calculation will be the price of the commodity at the time of signing the contract.

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[58]Most of the information was extracted from Maynard [Refs. 10 and 11] and Business International Corporation [Ref. 9].

[59]Export commodities linked to procurement are agricultural commodities, industrial goods, and other goods, excluding oil and natural gas.

- Exports must be directly channeled to the country from which procurement is being made. Exports to a third country are permitted only if this establishes a new market for that product;

- All contract bidders must sign a letter of obligation to participate in countertrade. Winners must submit a Letter of Undertaking, which legally binds them to make the required exports. The Department of Trade in cooperation with the commodity associations will monitor the implementation thereof;

- Export contracts must be completed prior to completion of government imports. Final payment to the foreign supplier will be made after the export obligation is realized; and

- Foreign suppliers are held responsible for compliance. A penalty (equal to 50% of the value of the portion of exports which have not been purchased) will be assessed for noncompliance.

4. Effectiveness

The effectiveness of an offset policy is very difficult to measure for several reasons. First, it is a new and growing element in international trade and not completely understood. Also, the long period of offset agreements implementation obfuscates any attempt in measure their impact. Finally, it is more difficult for recipient governments to follow up indirect offsets implementation because they cover such a broad range of activities [Ref. 6].

C. BRAZILIAN GOVERNMENT OFFSET POLICY

This section discusses basic issues of the Brazilian government trade and technology transfer policies and discusses the offset regulations of the Aeronautics Ministry (MAER).

Offset in Brazil is not yet well institutionalized. Even the term is not completely understood among government officials, industries, and trading companies. Within

the MAER, offset is understood in its limited concept of counterpurchase. Despite this general conceptual problem, the Brazilian government, specifically the MAER, has been requiring and controlling various agreements that involve countertrade, licensed production, coproduction, and primarily technology transfer. The MAER experience in negotiating various types of offset agreements is a result of a constant exchange of offset and technology transfer sectoral policies from other Brazilian government agencies responsible for overseeing different industrial sectors.

With the major exception of Brazil, virtually every country in Latin America has an official federal policy calling for offset and countertrade on major transactions [Ref. 12:p. 106]. Even without this unique official policy, Brazil has directed some selected offset transactions based on a set of scattered and pertinent regulations. In the following subsections, an attempt is made to condense several policies that affect directly or indirectly the aerospace industry into one "hypothetical" national offset policy. The pioneering effort of the MAER in issuing an official offset policy on a sectorial basis is also discussed.

1. Trade policy

The Brazilian trade policy has been subordinated to a strictly financial policy that results in the Brazilian market being one of the most restricted and self-sufficient in the world[80]. This policy is characterized by a restrictive import licensing regime, prohibited list of imports, exports incentives, market reserve, severe

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[80]Brazilian decision-makers argue that this control is necessary to foster indigenous technological growth and boost exports to service the debt [Ref. 13].

restrictions on the import of goods which contain microprocessor technology and considerable tariff, non-tariff, and bureaucratic hurdles [Ref. 13:p. 4]. It is important to recognize that offsets are a relatively small part of the overall trade policy. It is not easy to negotiate an offset for a $110 million contract of satellite launcher service if the major concern right now is signing a $3.6 billion rescheduling loan[61]. This subsection describes five main issues of Brazilian Government trade policy that indirectly is related to aerospace industry.

a. Offset Status

Despite persistent rumors that the Brazilian government is issuing specific regulations requiring offsets, recent interviews with Brazilian government officials indicate that this situation is somewhat complex[62]. It is unlikely that Brazil will opt for mandatory offsets on the Indonesian model, opting instead for treating offsets on an ad hoc basis. However, in the public sector[63], an increased utilization of countertrade by the large state-owned enterprises and trading companies such

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[61]Brazil has $120 billion external debt, inflation was 25% during June 1989, and totaled 964% a year. See "Brazil skips a payment of interest", Washington Post, 6 July 1989.

[62]The complexities involved in formulating a national policy for offsets was discussed in one telephone conversation with CACEX (Brazilian trade department), when it was confirmed that this topic has been hardly debated by the Brazilian government, and no short-term solution seems to have been reached.

[63]There is a clear distinction not only in offset policies but in other policies between private and public sectors in Brazil. The public sector is regulated by different legislation providing various incentives, protection and subsidies that the private sector does not have.

INTERBRAS is expected[64]. An increase is also expected in government-to-government accords that provide for the barter of needed raw materials and oil for Brazilian commodities and manufactured products [Ref. 9:p. 197].

The Brazilian government initiatives in fostering offsets are constrained, in large measure, by two factors. First, the IMF has taken a strong position against barter and countertrade and is using its leverage to limit the practice in Brazil. Second, these officials believe that barter and countertrade could hurt the Brazilian economy[65][Ref. 9:p. 198].

Although CACEX, the prime government arbiter for all import licenses, has not formally sanctioned countertrade as a legitimate method of international business, it has made known that it will consider import license applications arising from such transactions[66]. CACEX will be more disposed to approve deals that involve such high-priority imports as petroleum, health care,

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[64]INTERBRAS is the giant trading company subsidiary of PETROBRAS, the government-run oil corporation. It exports everything from agricultural commodities and shoes to machinery and petrochemicals. The INTERBRAS network has 19 branch offices around the world and had exports topping some $3 billion in 1983 [Ref. 9:p. 28].

[65]Brazil has entered into long term clearing accords (see Chapter Five on countertrade section for definition) with a number of Eastern Europe countries and found that it has shipped some $2 billion more in Brazilian commodities to those countries than it can generally buy from that area. This is a difficult position since it cannot get paid in cash for Brazilian deliveries nor can it find usable countertrade goods. This creates a lot of unclear thinking about offsets in Brazil.

[66]This research identified law No. 1807 of January 7, 1953 that prohibited CACEX from granting licenses for certain barter transactions. This law provides CACEX with power to look at private sector countertrade commitments on a case-by-case basis.

scientific instrumentation, and in the case of the export occuring prior to import (See "advance purchase" in Chapter Five in the coutertrade section).

Another reason for a more favorable view of offset negotiations in Brazil is its utilization by multinational companies as a vehicle for repatriating **blocked funds** - whether profits and dividends or capital assets. To operationalize this mechanism, the multinational company has to buy products in cruzados and export them as offset goods, keeping the hard currency proceeds abroad [Ref. 9:p. 201].

Several major countertrade deals have been made recently in the Brazilian aerospace industry:

- Brazil asked bidders on a $130 million space satellite contract for pledges to export Brazilian goods. Canada's Spar Aerospace won the contract jointly with Hughes Aircraft [Ref. 9:p. 199];
- EMBRAER negotiated with small U.S. airlines to sell six to twelve Bandeirante commuter planes. To obtain financing, EMBRAER has asked its U.S. suppliers, which provide some of the equipment for the Bandeirante, to import parts and components from EMBRAER. According to the president of EMBRAER, the firm obtained the financing it needed by convincing its prospective customers to ask regional banks to participate in the financing arrangements. The firm also set up a leasing operation through its U.S. subsidiary [Ref. 9:p. 198].

b. Export Incentives

Since the mid-1960s, Brazilian economic policy has tried to increase the export orientation of the industrial sector in order to relax the foreign exchange constraint faced by the country and to reduce the dependency on exports of a

small number of commodities. These efforts has been relatively successful[67]. However, the outcome has been a result of vigorous export incentives to achieve a moderate percentage of exports in the total manufactured output [Ref. 14:p. 53]. The Brazilian government offers various **fiscal** and **financial** incentives for the aerospace manufacturers who export their products[68]. None of these incentives is specific to the aerospace industry. The examples will give an idea of the extent of Brazilian aerospace industry utilization of these incentives.

The **fiscal incentives** group is represented by tax incentives and tax exemptions. They include the following series of tax benefits for the producer of export goods:

- Corporate Income Tax -- exporters of manufactured products may reduce their taxable income by the same proportion that export sales bear to total sales. In 1987, EMBRAER exported $332.6 million of a total sales of $474.5. It means, 70.1% of total sales was due to exports. The total net profit in this year was $12.9 million and $9.1 million (70.1% of net profit) was the reduction that EMBRAER was credited with.

- Tax on foreign remittances -- remittances of earnings abroad are subject to a 25% withholding tax but this amount may be reduced or refunded in amounts equal to an exporter's expenses for commissions, discount fees, advertising, international fairs, etc. EMBRAER may have a refund for expenses in the International Fair of Le Bourget, France.

- Drawbacks -- the drawback system authorizes exemptions, suspensions or refunds for exported goods of the duties initially paid for imported raw

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[67]From 1965 to 1980, exports of industrial products grew from 17.8% to 56.5% (about 40 times) of 1980's total $20.1 billion in exports [Ref. 14:p. 53]. Recent data show that Brazilian exports are booming, having jumped from just over $26 billion in 1987 to $34 billion in 1988 [Ref. 13], and industrial products in 1987 were 68.7% of total exports (this last percentage figure was calculated from Conjuntura Economica magazine).

[68]The idea of these incentives has been to compensate the loss of competitiveness resulting from the fluctuation of cruzados in real terms.

materials, parts and components. This arrangement also permits exemption or refunds of the **ICM** tax (tax on the Circulation of Merchandise) paid on such goods. Special legislation would even allow the duty-free importation of an entire factory into the nation, as long as its output is designated for export. EMBRAER enjoys exemptions of all taxes and duties which are based on the importation of raw materials, components, and equipments[69].

- Miscellaneous taxes -- operations connected with exports are exempt form **IOF** tax (tax on financial operations) which is tax imposed on the purchase of foreign exchange. In addition, international transport services are exempt from tax on transportation services and from social security contributions, as well as the tax on fuels when destined for export or for supplying foreign or national ships on international trips (the same example from previous tax benefit is related to the IOF tax).

The **financial incentives** offered by the Brazilian government may be divided in two categories:

- Credits, guarantees and insurance. As some other developed countries, the Brazilian government through CACEX has offered exporters insurance against risks such as expropriation, inconvertibility of currency, war, revolution or insurrection.

- Export credit. The Export Financing Fund, Fundo de Financiamento para Exportacao - FINEX, managed by the Central Bank but autonomously operated by CACEX may take the form of direct financing, loans to foreign importers of Brazilian goods, below-market financing to manufacturers for production of export goods, and funds for market research and development[70]. One famous example of the foreign reaction of this incentive was the Bandeirante case in the U.S. Although EMBRAER Bandeirante aircraft were welcomed by owners of regional U.S. airlines, some Canadian and U.S. manufacturers of similar aircraft began complaining in 1981 of the low interest rates (7.5% to 9%) and long repayment periods (7-8 years) being offered by EMBRAER to its customers, at a time when loans in North America were being offered at 12.5 to 22% with 5-6 years to repay. The U.S. Fairchild

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[69]This exemption was given in the same Decree law when EMBRAER was created in 1969 (see Chapter Four, subsection on government and industry relationship).

[70]Brazilian law also authorizes and heavily supports **trading companies** to act as intermediaries between buyers and sellers to facilitate the movement of goods and to develop foreign markets. Such companies also enjoy a number of tax exemptions and reductions [Ref. 15:p. 188].

Swearingen Corporation considered the situation so detrimental to its U.S. sales that it filed a countervailing duty petition with the U.S. International Trade Commission on August 13, 1982[71]. On September 21, 1982 the Commission voted, saying that there was no reasonable indication that an industry in the U.S. was materially injured or was threatened with material injury by reason of imports from Brazil commuter airplanes[72].

c. BEFIEX Program

Companies which accept a long term commitment (more than 10 years) to export a stipulated portion of their production may qualify for the special incentives granted by the Commission for Fiscal Incentives for Special Export Programs, Comissão de Benefícios Fiscais e Programas Especiais de Exportação - BEFIEX. This program allows the rebate of tariff and taxes imports of raw materials and components when those items are used in manufactured products destined for export. Incentives available under this program include a 70% to 90% reduction in importation duties or tax reduction[73] on imported machinery and equipment and 50% on imported raw material, components and intermediate parts. Profits attributable to exports may be totally exempted from income tax, and any losses of such firms may be carried forward for an extra two years. BEFIEX firms also qualify for accelerated depreciation for domestically produced machinery purchases. Although EMBRAER and other aerospace industries do not seem to

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[71]Fairchild alleged that these export incentives constituted an export subsidy.

[72]In May 4, 1982, the EMBRAER chairman eng. Ozires Silva defended Brazilian trade procedures at a Aviation/Space Writers Association Conference in Ft. Lauderdale, Florida in a speech entitled "Manufacturing Aircraft In Brazil - some fair trade issues" [Ref. 16].

[73]After the U.S. complaints that IPI credit was an export subsidy in violation of GATT agreement, Brazil eliminated the IPI "credit premium" for BEFIEX program in April 1985.

use this benefit, its impact in other industries seems to be quite large. Actually more than 400 firms have BEFIEX contracts with $87 billion in export commitments over the life of the contracts [Ref. 17].

d. Subsidies, Countervailing Duties and GATT Agreement

Export subsidies can be subject to retaliatory sanctions under the General Agreement on Tariffs and Trade (GATT) of which Brazil is a member[74]. A countervailing duty is a charge imposed by an importing nation upon goods subsidized by the country of origin; such duty is intended to offset the "unfair advantage" the foreign items, as a result of the subsidy, would have over similar domestic products [Ref. 18]. The Subsidies Code recognizes that subsidies are an integral part of many development programs and asserts that the developing nations are not subject to any retaliatory action for simply granting export subsidies [Ref. 18]. In this case, Brazilian domestic subsidies such as government grants, loans, and guarantees are not considered subsidies under this Code.

Specifically in aircraft trade, the U.S. government and the General Aviation Manufacturers Association and its members, would like to see the Brazilian Government sign the GATT agreement on Trade in Civil Aircraft and eliminate the 20% tariff on general aviation aircraft[75], as well as a 7% tariff on all other aircraft and

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[74]See the Code on Subsidies and Countervailing duties, GATT April 12, 1979 (Subsidies Code). The prohibition on export subsidies does not apply to domestic subsidies [Ref. 18].

[75]This tariff rate was established in 1975 (see the Piper case in Chapter Five) and remained 50% until 1986 and then was reduced to 20%. Recent reports shows that the Brazilian government is dropping import duties on aircraft components.

a 5% duty on parts and components for the aircraft industry [Ref. 19:p. 11]. The U.S. is investigating Brazilian subsidies during numerous countervailing duty investigations. Under this pressure Brazil has lowered the subsidization level.

e. Trade Barriers

Virtually all Brazilian imports require an export license from CACEX. This import licensing process serves to implement and control restrictive programs. Although the "New Industrialization Policy" (NIP) promulgated in May 1988 makes licenses more likely, CACEX still retains discretionary power to delay or deny import permission for a wide range of products[76].

The "law of similars" is a protectionism law (actually a collection of laws and regulations) that denies an import license to products "similar" to competing products produced or capable of being produced in Brazil. Although the law ("buy national") requires the similarity test only if the importer is a government controlled entity or seeks government benefits or incentives, CACEX actually applies this test to an estimated 90% of Brazilian machinery and capital good imports. Theoretically, government agencies may purchase an imported item if the price of the national good is at least 15% higher than that of the import. However

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[76]The NIP aims to modernize Brazilian industry through a departure from the import substitution model that no longer attracts investment, produces indigenous technological capacity, or encourages industrial productivity and efficiency. The new stated objectives are (1) Increase the efficiency, productivity, and competitiveness of Brazilian industry, (2) increase Brazil's autonomous technological development and (3) reduce progressively the dependence on government stimulation of industry. To implement these goals, the Brazilian government is reforming the tariff structure, simplifying the import of 3000 products, and restructuring the fiscal and financial benefits to industry [Ref. 13].

political pressures make it virtually impossible for government agencies to purchase foreign goods if a domestic product is available.

Brazil has been accused by the U.S. of unfair trade. In 1988, the Trade and Competitiveness Law was approved in the U.S. revealing the new spirit of the U.S. government in solving this controversy unilaterally. The Super 301, a new name of this U.S. trade law, sanctioned Brazil, India and Japan based on charges of unfair trade. These three countries refused to submit to a bilateral "negotiation" under the terms of the Super 301 clause. Brazilian officials said that the trade restrictions adopted by Brazil are acceptable under international law in view of the serious problem existing in its balance of payments [Ref. 20]. As a result of these actions, aerospace industries in both countries are concerned with the future consequences of this conflict. EMBRAER has in the U.S. an excellent market for the Brasilia aircraft. Hughes, concerned about losing the bid for the two new Brazilian satellites, asked for some U.S. official support to ameliorate the negotiation climate[77] [Ref. 23].

In summary, Brazil does not have an official offset policy that regulates the most expensive imports. A summary of various trade laws, regulations, barriers, and incentives shows a complicated international trade environment in Brazil that parallels the economic situation. The Brazilian

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[77]As a part of section 301, in October 30, 1982, the U.S. President ordered retaliation and imposed a 100% "ad valorem" tariff against $39 million in Brazilian goods. The matter has been discussed under the GATT settlement procedures [Ref. 17].

government has been accused of unfair trade, and developed countries have applied serious measures of retaliation.

2. Technology Transfer Policy

Among Latin American countries Brazil has given the most explicit attention to the role of technology in economic development and to the stimulation of technological development through government policy. The purpose of this subsection is to provide a summary review of the main aspects of Brazilian technology policy, particularly as regards the aerospace industry sector. In the next chapter, the specific strategies and policies of the Aeronautics Ministry to foster technology will be discussed. The main policies affecting technological development in the case of Brazil are grouped in the following three headings[78].

a. Development of Technological Infrastructure

Before 1968 most of the effort in this area focused on institution building and human resource development. The period between 1920 and 1950 was characterized by the creation of various Research and Development (R & D) institutions in engineering and the sciences, including the Aerospace Technology Center (CTA)[79] in 1954. The primary objective in this period was to stimulate and finance the development of high-level resources in order to strengthen Science and Technology (S & T) capability, particularly in the universities and in research and development institutions [Ref. 14:p. 95].

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[78]The idea of dividing this discussion into these headings is derived from the World Bank Country Study [Ref. 14:p. 95].

[79]See Chapter Five for a more detailed explanation of this Center's activities in the subsector government-industry relationship.

Beginning in 1968 , scientific development became a specific policy objective. The 1968-69 Development Plan, Programa Estratégico de Desenvolvimento (PED), defined an explicit policy for S & T for the first time at the federal level[80]. Although there were some important differences in the priorities of the PED and those of subsequent plans, the program of action and institutional structure then established for planning have been maintained [Ref. 14:p. 96].

In the industrial sector, the most important development was the creation of the Secretaria de Tecnologia Industrial (STI) of the Ministry of Industry and Commerce (MIC) in 1972. It was the first sectoral S & T unit to be established within a ministry, in the civilian sector [Ref. 14:p. 98].

b. Regulation of technology imports

The strategy towards imports of foreign technology is a key element of technology policy in developing countries. This includes not only specific policies on the importation of disembodied technology (such as licenses and technical services) but also those relating to the inflow of foreign investment and to the control of imports of technology embodied in capital goods [Ref. 14:p. 98].

Since 1971, the National Institute of Industrial Property, Instituto Nacional de Propriedade Industrial - INPI, has been assigned to regulate the incoming flow of technology assuming that such know-how is effectively utilized. Initially INPI sought to: (1) evaluate whether the technology should be imported; (2)

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[80]Among specific development strategies were the construction of a strong industrial base, absorption of foreign capital, technology and managerial capacity, modern industrial technology to increase competitiveness, creation and adaptation of technology and open new markets for manufactured exports [Ref. 15:p. 182].

reduce the cost of the imported technology by strengthening the bargaining position of the local licensee; (3) eliminate clauses restricting the local absorption and dissemination of the imported technology; and (4) favor the importation of technology rather than capital goods. In 1975, INPI issued a policy statement establishing the norms and concepts for the regulation and approval of technology transfer agreements. Specifically, INPI is responsible by law for the registration of patents and trademarks owned by foreigners and the approval of import licenses that involve the technology transfer and patent and trademarks licensed agreements that utilizes foreign technical assistance [Ref. 15:p. 190]. Each type of agreement must be registered, terms and payments authorized, and various special provisions depending on the type of contract. The main expansion from the previous regulations consisted in making transfer conditional upon absorption of technology by recipient firms. This is implemented by demanding full disclosure of technical knowledge by the suppliers of the technology, and by the requirement that the recipient firms present plans for the absorption of the technology and for the local personnel training.

The impact of INPI's attempts to control the imports of technology and to develop the technological capability of the importing firms seems quite large. However, despite this control and regulation, it seems that most of the military technology transferred to the aerospace industry only involves the military ministries. Some complaints from various people involved in the technology transfer with respect to INPI are that it is too bureaucratic, has an insufficient number of

personnel for its large regulatory task, and is more worried about reducing the outflow of foreign exchange than with technological development [Ref. 14:p. 100].

c. Development of Technological Capabilities

The Brazilian government support in the technology area can be grouped in two categories: direct and indirect. The **direct government programs** are divided in four categories:

(1) Direct Financial Assistance

The main instrument used in Brazil to encourage the development of technological capability has been the provision of subsidized financing by FUNTEC and FINEP. FUNTEC was created based on previous experience with large investment programs which were identified with strong technological dependence with respect to product, process, and project engineering. To ameliorate this problem, FUNTEC supported the development of human capital in S & T disciplines, stimulated and supported research and innovation by local industry, and adapted imported technology to local conditions. FUNTEC activities are funding postgraduate training for scientists and engineers, strengthening the Subprogram on the Demand and Utilization of Technology to stimulate R & D, and the Subprogram for Generation and Supply of Technology to attract research institutions and universities to participate more directly with the firms' efforts [Ref. 15:p. 184].

(2) Direct Technical Assistance

FINEP has a program to strengthen the capacity of national consulting firms to assist the development of new techniques [Ref. 15:p. 186].

(3) Scientific and Technological Information

The National System of Scientific Information, under the Conselho de Nacional Pesquisas (CNPq), is committed to information services which enable Brazilian industry and government agencies to obtain current data on technology developments in their fields [Ref. 15:p. 186].

(4) Direct Research and Development Programs

The Brazilian government's development programs are being counted on to increase indigenous technological capabilities with locally developed know-how [Ref. 15:p. 186].

The Brazilian government's indirect programs are basically three: (1) a program to strengthen the financial position of the Brazilian firm (capital funding); (2) measures to stimulate domestic and foreign market demand (utilization of government procurement); and (3) programs to establish standards and norms (certification of product quality standards by INMETRO - National Institute for Metrology, Standardization and Industrial Quality).

Summing up, the Brazilian government has been developing since the mid-1960s various technical and financial incentives to foster the research and development of indigenous technology and to facilitate the transfer and absorption of foreign technology. A plethora of laws has been created to control and channel the technology transfer process. The tasked agency, INPI, has not assumed a fixed methodology in approving technology transfer and licensed production agreements. Finally, the transfer of military technology seems to bypass all these bureaucratic processes [Ref. 15:p. 187].

3. Brazilian Aeronautics Ministry Offset Policy[81]

The Brazilian government's first initiative in issuing regulations regarding offset policy[82] was through the Aeronautics Ministry (MAER). There are various reasons for this pioneerism. First, the Aeronautics Ministry was particularly concerned in establishing an overall policy that involved both the Department of Civilian Aviation (DAC) and the Brazilian Air Force (FAB), as well as EMBRAER, CELMA, and INFRAERO, which produce aircraft, aircraft engine parts, and air traffic control, respectively[83]. Second, perhaps the Air Force is still concerned with technology dependence for the development of the military aerospace industry[84]. Finally, there was a great deal of previous experience obtained in foreign acquisition of jet aircraft, significant participation in international license and coproduction agreements, and the establishment of Brazilian Aeronautical Commissions in Washington and London.

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[81]This subsection is based on the author's own experience in the Brazilian Air Force and with the regulations cited throughout the text of this subsection.

[82]This is a sectoral policy applied more for general aviation. An interview with the MacDonnell Douglas Co. department of offset and countertrade brought attention to one curious detail. Brazil, as different from other countries, initiated official offset polices for civilian offsets, whereas other recipient countries, concerned with GATT agreement transgression, regulated only military offsets.

[83]The Brazilian Aeronautics Ministry controls the Brazilian Air Force, Department of Civilian Aviation, and has majority control over preferred shares of three state-owned companies: EMBRAER, CELMA, and INFRAERO. For more detailed explanation, see Chapter Three.

[84]There is no intention to discuss the other services' technology dependence. Ellis offers discussion about the Brazilian Navy technology dependence [Ref. 22].

The MAER's regulations about offset were recently published, although they represent an aggregate experience from previous regulations since 1981. The first regulation is Portaria[85] No. 434/DGAC of Dec. 14, 1988 that prescribes requirements for planning technical controlling and commercial offset of Civil Aviation Renewal Programs. The second regulation is called Portaria No. 230/GM4 of April 6, 1989 that establishes the need of including offset clauses in contracts of acquisition of aeronautics engines and accessories by FAB, airlines, and EMBRAER, with the objective of manufacturing spare parts, assembly, and test of this equipment inside the country.

a. Aeronautics Ministry Offset Program

To understand the MAER offset program we need a background to the DAC and its responsibility in controlling the Civilian Aviation in Brazil. Since the creation of MAER in 1941, the Aeronautics ministry has supervised the Department of Civilian Aviation (DAC). In 1981, a Decree-law created a commission called Comissão de Coordenação do Transporte Aéreo Civil - COTAC, under the general Director of DAC. COTAC is responsible for proposing to other government agencies technical, economic and financial measures for the harmonious development of the civilian aero-transportation industry programs, and following-up and supervising the execution of these programs[86].

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[85]Portaria is a regulation issued by Brazilian government ministries.

[86]Every importation of aircraft shall be approved by COTAC which is also responsible for giving the prefix of the aircraft to be operated in Brazilian airspace.

A new COTAC restructured in 1987 integrates representatives of the Central Bank (director of external area), CACEX (trade department under Bank of Brazil), and other departments of MAER, including CTA/IFI[87]. Since 1981, one of the functions of this commission has been requiring offset clauses in major general aviation acquisitions.

Due to administrative problems, lack of publicity of offset policy, and primarily no establishment of an effective instrument of control, the offset policy was not successful. Some government officials estimate that about $200 million was lost in export opportunities[88]. Another critical reason for this failure was the incapacity of the Brazilian aircraft industry to provide products and services with international quality to satisfy the suppliers' demand in counterpurchase contracts.

In December 1988, DAC issued regulations establishing mandatory offsets for general aircraft imported by Brazilian operators. Here are some policies and procedures extracted from this regulation[89]:

- All aircraft[90] importation and contracts for major services abroad are subject to commercial offset obligations to be fulfilled following the final steps of the negotiations.
- The final phase of the negotiations between operators and foreign aircraft and services suppliers shall be forwarded to DAC through a Purchase Program

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[87]See acronym meanings in Appendix A.

[88]This author's estimate is about 10% of the total aircraft imports from 1980-1986.

[89]The translation of the original regulation from Portuguese is entirely the author's responsibility.

[90]This may include expensive aeronautical parts, such as replacement engines, ramp equipments, simulators and others, at DAC's discretion.

Communication (Comunicação de Programa de Aquisição - CPA) containing: object, quantity, delivery time, value, nature, and other basic elements of contracting.

- To comply with the CPA, the Commercial Offset Commission (Subcomissão de Compensação Comercial - SCC) will issue the offset program defining percentages, deliveries, and specific conditions.

- The commercial offset programs are applicable to the aircraft's negotiations, regardless of the contract type, i.e., purchase, leasing or commercial renting in accordance with the following conditions:

  - Purchase or leasing -- minimum of 10% of the F.O.B. value of the negotiations;

  - Commercial renting -- same values as above, adjusted by contractual time serviceable life time ratio; and

  - Expenses due to spare parts, training and documentation costs will not be included, as well as financial burdens related to interest and other bank fees.

- The time to accomplish the prescribed offset values (implementation time) will be up to ten (10) years depending upon the supply conditions, taking into account the contract amount, the interest of the supplier, and the market conditions.

- The following elements are eligible for commercial offset, and may be included in the contracts:

  - Aeronautical services and products made in Brazil, including ground support equipments;

  - Finished or semi-finished products for aeronautical application;

  - Effective know-how transference in aeronautics;

  - Aeronautical services and products made in Brazil purchased or financed by the manufacturer and forwarded to the Brazilian operator; and

  - Technical support proposed by the foreign supplier and accepted by the Department of Civil Aviation benefiting the Brazilian operator, its associates or the Civil Aviation System.

- When the support is considered relevant and valuable and has a multiplier effect in the economy, it can be ascribed an amplification factor of the contract's value[91].

- The DAC will follow up the negotiation developments between the operator and the supplier within the limits pertaining to government assistance. DAC also will offer the necessary help for the evaluation and judgement of documentation in course at COTAC, promoting the adoption of rules, adjustments and measures which, may be necessary to the implementation of SCC.

- Each aeronautical foreign manufacturer will have a current account, and it may be possible to have an adjustment for subsequent agreements. The engine manufacturers, whose offset will be proportional to their participation in the final value, will have a subcurrent account assigned to the aircraft manufacturer.

- Unclear cases or those subject to interpretation will be submitted to the DAC Director, for a final decision.

In April 1989, the Aeronautics ministry issued a regulation that involves the acquisition of aircraft engines and spare parts. At this time, the motivations for the regulation were: minimizing the use of hard currency for the acquisition of spare parts and accessories for imported aircraft engines; establishing inside the country an industrial base with capacity to participate in the production of spare parts and accessories for aircraft engines; and based on international experience, the establishment of a government policy to foster the growth of this industry sector. This regulation seems to complement the first one and applies to the Brazilian Air Force, in addition to national airlines and EMBRAER. The inclusion of the Air Force is evidence of the Brazilian government's concern in regulating military offsets.

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[91]To be understood as a price increase.

In summary, the Aeronautics Ministry offset policy is the first step in constructing a policy in this complex area. The way chosen to start is through the import of civilian jet aircraft for the Brazilian airlines. It has been noted that an evolution in this sectoral offset policy is expected as it shifts from civilian to military offsets. Although there is no official policy with respect to military offsets, the MAER has been applying its offset agreement policy to technology transfer to develop its aerospace industry.

IV - THE BRAZILIAN AEROSPACE INDUSTRY

This chapter provides a background of the structure and development of the Brazilian aerospace industry. The **first section** gives the introduction. The **second section** describes the Brazilian aircraft industry with special focus on EMBRAER because it is involved in the majority of the cases that will be analyzed in this thesis; under this section the helicopter and aeronautical engines industries will also be covered. Within the same section the government and industry relationship and support, the market evolution, and the technology strategy of the aircraft industry will be analyzed. The **third section** focuses on the Brazilian space and missile industry. The Brazilian space program, the role of the missile industry, and the technology barriers of this industry will be discussed.

A. INTRODUCTION

The development of the Brazilian aerospace industry is a good example of a developing country searching for offsets that involve the transfer of high-technology to improve the aerospace industrial base. Brazil today produces indigenous aircraft and missiles, assembles helicopters and aircraft engines under licenses, and has developed an ambitious space program which includes a domestic vehicle launch and satellites.

The Brazilian aerospace industry has developed a model that may be followed by aerospace industries in other developing countries. State participation through ownership, market opportunities carefully studied, government-financed R

& D, protective barriers, and special fiscal incentives have been the essential ingredients used by the Brazilian government through the Aeronautics Ministry.

Brazil is a big country in the Southern Hemisphere. It has a population of 145 million people within an area of approximately 8.5 million square kilometers. Although it has a lot of potential to be explored, numerous problems have provided constraints to its development. Brazil has the largest external debt of $120 billion in the world, the internal inflation is close to four digits, and its population is growing very rapidly.

The problem of establishing compatibility between the need for national defense of a country and dealing with economic constraints is a constant exercise in allocation of scarce resources. Increasingly concerned with its social programs, the Brazilian government's military expenditures have shrunk to meet its minimum needs.

The Brazilian Air Force (FAB) has the primary mission to protect all the air space, which includes surveillance of the 200-mile ocean coastal zone. To accomplish this significant task, the FAB has a small fleet of fighters, transport and trainer aircraft, and helicopters, most of them technologically pressed accomplish the increasing mission requirements.

The Brazilian government's participation in supporting the aerospace industry has been a principal factor in the development of this industry. However, various aerospace companies have enjoyed different levels of support, depending on the government's interests and the companies' political leverage. This difference is also perceived among various programs and during different periods. Today, some

specialists forecast a trend to "privatization" of these industries, but as in the U.S., they will continue to be extremely dependent on political and financial government support.

In terms of technology strategy, unlike many developing countries whose industries have been based for many years on local assembly under license of equipment developed abroad, Brazil has emphasized the development of independent programs, using partnership rather than a subcontracting basis [Ref. 1:p. 205]. This strategy has provided Brazil with a capacity to "stand alone among South American countries in having established the most advanced aerospace technology base of the developing countries" [Ref. 2].

The market evolution and strategy efforts of the Brazilian aerospace industry has been unintentionally aided by the developed arms exporting nations. For example, by the end of the Vietnam war, the U.S. military was enamored of glamorous "high tech" weapons and increasingly ignored the development of simpler systems. The Brazilian arms industry, specifically the aerospace industry, quickly moved into the breach. As one U.S. government official in Brazil said, "Their success was built on filling needs other people weren't filling" [Ref. 3]. Brazil has developed indigenous inexpensive weapons with simple operation and maintenance, adapted to third world requirements. However, as the Brazilian aerospace industry has moved to "high tech" weapons to become more competitive and as a result of the country's overall technological development, this strategy cannot be applied anymore [Ref. 3]. Instead, the Brazilian industry is moving to more complex products. As a result, Brazilians have secured more

advanced foreign partners anxious to share technology liberally in exchange for low labor costs and other advantages[92]. Another aspect of the Brazilian arms market success has been its strictly "commercial" interests[93]. This allows Brazilians to sell arms to practically any country that would like to buy them, without imposing any end-user constraint. This has enabled Brazil to obtain a larger share of the market, mainly in countries where the U.S. international policies have been restricting arms transfers, or transfers made by other countries which the offered equipment has any component made in the U.S. or under a U.S. license[94]. This known "pragmatic" policy has been known to restrict certain sales. It is administered by a secretive organization in the Brazilian government called PNEMEM (Política Nacional de Exportação de Material de Emprego Militar) which monitors the Brazilian arms sales through licenses [Ref. 5:p. 60].

Within this somewhat complex scenario, the emergence of Brazil as the largest third world arms producer leads to a major question. How was Brazil able to develop its aerospace industry, in spite of its numerous problems?

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[92]The best example of this change is the Avibras FILA system. For the first time since Avibras was created, it contracted foreign technology to meet the Brazilian Army requirements (See more information on Avibras in this Chapter).

[93]The rationale expressed by Brazilian government officials is that the "commercial" concern must be understood as the impossibility of Brazilian arms industry survivability without export.

[94]This kind of open Brazilian foreign policy applied to arms sales will be focused in further discussions related to the U.S. government restrictions in technology transfer to Brazil. The case of Brazil-Libya arms transfers is actually the main reason restricting the transfer of U.S. missile technology to Brazil. For a complete analysis of the Brazilian arms transfers and foreign policy see Tollefson [Ref. 4].

B. THE AIRCRAFT INDUSTRY

1. Historic events

The recent emergence of the Brazilian aircraft industry[95] in the international aircraft market has been surprisingly rapid, but Brazil has a distinguished aircraft history. For the Brazilian people, Alberto Santos Dumont is considered the "father of aviation" and for the Brazilian air force, he is the "Patron of the Air Force"[96].

The Brazilian aircraft production history is divided in two phases. The industry before EMBRAER, and the industry after the creation of this company[97].

Since 1910 various individuals have designed and flown planes in Brazil but only in the 1930's did the government and military began noticing the importance of aviation. The first Brazilian plane made in series was the MUNIZ M-7, manufactured by the Fábrica Brasileira de Aviões. Since then, other industries have produced a variety of small aircraft, mainly for training of the increasing number of pilots. In 1941 the Aeronautics Ministry was created, bringing both civil and military aviation under one organization. At the same year, the Aeronautics Ministry ordered 110 HL-1 units made by Companhia Nacional de Navegação Aérea (CNNA) [Ref. 1]. The most successful Brazilian-made plane before EMBRAER was produced by Companhia Nacional de Aeronáutica (CAP). More than 700 units of

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[95]Brazil has emerged as the sixth leading aircraft production (by volume) nation in the world [Ref. 6].

[96]The Brazilian Alberto Santos Dumont designed, developed, and flew the first heavier-than-air craft in Paris, 1906 [Ref. 1].

[97]The author decided to follow this division that was previously suggested by Moxon [Ref. 1] in order to emphasize the importance of EMBRAER in the evolution of the Brazilian aircraft industry.

CAP-4 were sold during this period. The plane used virtually all Brazilian-made parts except the engine and most of them still are being used in air clubs. The end of World War II resulted in reduced interest by the government in aviation production, once many war-surplus planes were available on favorable terms. Orders from the government for homemade planes became scarce, and FAB, CNNA and CAP all closed their doors [Ref. 1].

Some other ambitious projects supported by the government after World War II are outlined below:

- The "pet" project of President Getúlio Vargas in Lagoa Santa, in Minas Gerais state in 1936 to produce North American T-6's under license[98];
- The Navy project with Focke Wulf, from Germany, to build four aircraft models with German technology in a Navy-furnished factory in Rio de Janeiro, in 1940[99];
- The U.S. licensing production of large number of a Brazilian version of the Fairchild PT-19; and
- The Galeão factory's[100] joint venture with the Dutch company Fokker of S-11 and S-12 trainers.

The same problems involved in establishing an airplane manufacturer apply to an aircraft engine plant. In 1930 the Army established the Fabrica Nacional de Motores (FNM) in Rio de Janeiro, with a licence agreement from the U.S. Wright company. The main reason for the lack of priority in the continuation of this

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[98]Today this factory is a maintenance facility of the Air Force.

[99]World War II interrupted that project, as the Brazilians and Germans found themselves on opposite sides in the conflict. Later the factory was absorbed by the Aeronautics Ministry.

[100]Today the Galeao's factory is a maintenance facility of the Air Force.

industry was also the war. The U.S. offered war-surplus engines within the aircraft packages and the plant was converted to making truck motors.

In the 1950's and 1960's some private entrepreneurs decided to invest in aircraft production and founded two companies. The first one was Construtora Aeronautica Neiva (Neiva) that produced gliders and the CAP-4 Paulistinha. From this firm, the Aeronautics Ministry ordered some aircraft trainers for Air Force cadet training, such as Regente (240 units) and T-25 Universal (150 units). Since 1980, Neiva has been incorporated with EMBRAER and is responsible for assembling the line of light planes made by EMBRAER under license from PIPER[101]. The second company was Aerotec (founded in 1962), and had a rapid expansion with the production Uirapurus trainers for both civilian and military application. Today, like Neiva, some of the company's production line is conducting subcontracting work for EMBRAER[102].

The history of the Brazilian aircraft industry prior to the 1970's shows a mixed picture. Under government sponsorship, over 2000 aircraft were produced for the Air Force and air club operations. The utilization of war-surplus aircraft and engines saw a short-term decline in indigenous production. But things changed in the mid-1960's, and the opportunity to become more independent finally happened.

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[101]This will be discussed with the PIPER case in the next chapter.

[102]Aerotec was expected to sign agreements with Italians firms to build the SM-1019 single-engine scout/liaison aircraft under license, as well as the S-700 Cormorano amphibious plane [Ref. 7].

2. The Aircraft Companies

This subsection covers the three main Brazilian aircraft companies. It includes EMBRAER and its subsidiaries, the major aircraft company; HELIBRAS, the helicopter company; and CELMA, the aircraft engine company. This overview will be useful as a background for most of the cases in Chapter Five.

a. Empresa Brasileira de Aeronáutica (EMBRAER)

In 20 years EMBRAER became the most important company in the Brazilian aerospace industry and a significant participant in the international market of aircraft[103]. The objective of this part is to describe EMBRAER's development of its main indigenous projects[104], the government support and partnership, and the importance of the competitive market evolution and technology strategies of this company.

(1) EMBRAER's development

With the experience of past aircraft venture failures, the Brazilian government and private investors were reluctant to invest in another dream. Few Brazilians continued with the idea of self-sufficiency in aircraft production. At the same time, the Air Force was looking for a plane to replace the medium-sized transport. The first step was the development of an indigenous project inside the Aerospace Technical Center (CTA), in a small group under the leadership of Captain Osires Silva. The Institute of Research and Development

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[103]EMBRAER had built a total of 3773 aircraft by the end of 1987 in three basic categories of aircraft - commercial, general aviation, and military [Ref. 8:p. 10].

[104]The projects that required some international agreement will be emphasized in the case studies descriptions in Chapter Five.

(IPD) projected a called IPD-6504 aircraft prototype, a two engine transport turboprop, 8-10 seats, non-pressurized, designed by the team headed by a French aeronautical designer Max Holster. The name of the aircraft was Bandeirante (Pioneer). Overcoming various obstacles, the prototype successfully flew for the first time in October 26, 1968, over 3 years after the proposal was approved by the Aeronautics Ministry[105].

The next step was the creation of EMBRAER in 1969. As said before, experience with the previous private failures and with no interest from internal and external private sectors to establish an aircraft company, the Brazilian government decided to set up a factory of its own. EMBRAER has been a state-controlled enterprise but managed like private companies by a board of directors. The President of EMBRAER, however, is nominated by the President of Brazil with three others directors. The other two directors are elected at the general body meeting of shareholders. The "director superintendent", or the managing director, is the only full-time member of the board[106] [Ref. 6:p. 424].

(2) Government and industry relationship

The Brazilian government challenge and top-priority has been the development of a viable aircraft industry based on domestic designs and future

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[105]During this period Max Holster, doubting Brazil's ability to mass produce an aircraft, left the design in the hands of two Brazilian engineers of the original team. One of them, Fontegalante Pessoti, later became Embraer's first technical director and is still holding that job.

[106]The Presidency and also the Superintendency of this company was given to Col. Osiris Silva who continues to supervise the company today. Mr. Osiris is a retired pilot officer and also an aeronautics engineer educated by ITA.

international cooperative development programs that will provide the country with an infusion of advanced technology and consequent national pride. Since the beginning of EMBRAER, the government has been contributing in two major fields, fiscal and financial support and R & D support and finance[107].

The first government initiative was **fiscal and financial support**. It started by capitalizing EMBRAER as a mixed economy company[108]. One may be surprised by this fact. If the government decided to establish an aircraft industry, why does it not establish a 100% state company, as the Argentina government did? One of the explanations of this approach is that the military regime that came to power in 1964 defended capitalism and free enterprise[109]. The creation of EMBRAER at that time required a large investment and for obvious reasons the risk was extremely high[110]. In August 19, 1969, the Presidential Decree-

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[107]These two fields were chosen because of their importance in the offset agreements. Other government support, such as high-ranking officer and government official travels to foreign countries and issue of an arms catalogue by Itamaraty, both to improve international arms marketing, were not considered. [Ref. 9:p. 8].

[108]Such mixed economy corporations are legal entities (called "estatais") created in Brazil by special legislation to carry out a specified economic objective. They were developed in the hope that they could move rapidly and efficiently by following the practices of a private company, without the risk of bankruptcy and enjoying other privileges [Ref. 10:p. 52].

[109]Moreover, the Brazilian Constitution at that time authorized the state to enact legislation intervening in the economy when necessary to establish an economic sector which otherwise could not be effectively developed through private initiative and free competition [Ref. 10:p. 50].

[110]The reasons previously addressed for the private investors refusing to invest their money was complicated by the fact that the aircraft industry requires a long term of return on investments and at that time, other investments were giving faster

law No.770 created EMBRAER that stipulated the initial capitalization of 51% of the voting shares (ordinary shares) which gave the government the company control. The remainder of the shares would be offered to private Brazilian companies. With the objective of providing incentives to private investors to invest in EMBRAER, the Brazilian government extended to the company shareholders the same fiscal benefits that were applied to other companies in priority regions or industry sectors[111]. The Brazilian government through EMBRAER, however, was offering more advantages than these previous benefits. Any company operating in Brazil can take a 1% ceiling from its income tax and buy EMBRAER shares. This means the investment costs nothing to the tax payers. The interesting point was that the acquisition of EMBRAER stock was not included within the 50% limited proportion on combined investment tax credit, which permitted EMBRAER investors a maximum total credit of 51%[112]. As a result, EMBRAER shares have been sold in large amounts, reducing government participation to the minimum necessary to control the company[113]. Another fiscal incentive enjoyed by EMBRAER involves

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and better returns besides offering lower risk.

[111]Some regions such as Amazon and Northeast, and some industry sectors like tourism, fishing and reforestry were the focus of many government incentives. The government allowed the shareholder to invest a proportion (up to 50%) of their income tax in these companies [Ref. 10:p. 528].

[112]EMBRAER has adopted a slogan "surpass the 51% barrier on income tax credits" [Ref. 11:p. 43].

[113]The company started its operation in 1970 with only 500 firms (most of them were local business hoping to supply parts or accessories to EMBRAER) and now has about 250,000 shareholders [Ref. 11]. Today over 90% of the shares are in private hands and the government has the control of 51% of the voting shares [Ref. 5:p. 52].

basically the whole government tax exemption system. The same Decree law of the creation of the company had exempted it from paying most of the existing tax on export or import transactions, on the domestic aircraft commercialization, and even services tax - Imposto sobre Serviços (ISS) and Property tax - Imposto sobre Propriedade Territorial Urbana (IPTU)[114].

EMBRAER can also benefit from some government **financial support** such as land donation[115], capital to support facilities construction and development cost in a cost-plus fee contract basis[116], and loan guarantees[117].

The Brazilian government **R & D support** to the aircraft industry is additional evidence of the its "partnership" with the aerospace industry. This support is expressed through the technological development inside government organizations which release the company from the R & D risk, certification of quality assurance in international patterns (e.g., using U.S. FAA regulations), utilization of R & D installations (e.g., wind tunnel), and various other kinds of support.

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[114]These two last taxes are for the local government and are collected by the city council. The mayor exempted EMBRAER since its creation until 1990 (information from EMBRAER).

[115]The company main plant was constructed just beside the CTA in a public land donated to EMBRAER by the Aeronautics Ministry. This facilitates the company access to the airport and to the numerous other CTA facilities.

[116]The Brazilian government has supported the development costs and the necessary facilities for the AM-X program [Ref. 5:p. 54]. Another example was the development of the Tucano trainer contracted in December 1978 [Ref. 8:p. 13].

[117]The Brazilian government covered $80 million of a international loan from the Royal Bank of Canada to be applied in the Brasilia aircraft development estimated at $200 million [Ref. 12:p. 19].

The Aerospace Technical Center (CTA) is mainly responsible for this division of labor. The CTA conducts state-sponsored research to support the aerospace manufacturing firms and consists of the following five institutes:

- **ITA - Instituto Tecnológico de Aeronáutica** - It is a technical educational institute that grants undergraduate and graduate degrees in aeronautical, mechanical, electrical, electronics, and aeronautics infrastructure engineering[118].

- **IPD - Instituto de Pesquisas e Desenvolvimento** - It is the aeronautical research institute, with divisions of aeronautics, electronics, mechanics, and materials[119].

- **IAE - Instituto de Atividades Espaciais** - It is responsible to develop the space research and is particularly involved in the SONDA rocket program.

- **IEAv - Instituto de Estudos Avançados** - It develops research on frontier technologies.

- **IFI - Instituto de Fomento e Coordenação Industrial** - It is responsible to promote liaison between CTA and industry. Specifically it issues certification for Brazilian made aircraft and parts, assists on technology transfer, promotes marketing support, and is the one key government agency that oversees the technical implementation of offsets.

Today EMBRAER has an in-house technological capability that is sometimes better than that at the CTA.

One of the formidable tasks of the IFI has been to improve the certification of more suppliers from national industry to meet the requirements of EMBRAER and also the international requirements. Like EMBRAER, these

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[118]Since 1950, ITA has graduated over 72200 engineers and granted over 300 postgraduate degrees. Probably about 10% are military officers but the civilians are sent not only to EMBRAER and AVIBRAS but to nearly all the successful supplier firms in the Brazilian aerospace industry [Ref. 5:p. 51].

[119]This institute was responsible for the design and development of the Bandeirante project IPD-6504.

suppliers cannot support the economies of scale needed to manufacture most aircraft parts or subsystems just with domestic demand. Therefore, in addition to offering quality control education, IFI is assisting these companies in identifying international markets. IFI is using the Brazilian airlines purchases in international aviation markets as a leverage to establish offset agreements and to bring contracts to smaller firms. This activity is now regulated by the Aeronautics Ministry (see the Aeronautics Ministry offset policy in Chapter Three).

(3) Market strategies

Rather than being forced by military control to produce only military planes, EMBRAER has developed products that are in demand internationally and are viable economically, given Brazil's technological and economical constraints[120]. Early on EMBRAER learned that even with a domestic protected market, the domestic market is too small to sustain an internationally competitive company for the long term. Although the domestic market, including the FAB orders, has given a relatively assured base, the company has been careful to design planes that have good export prospects [Ref. 35:p. 195]. The case of the Bandeirante project illustrates this behavior. Since the beginning of the program in 1965, the aircraft has been developed to support two requirements. The first is the civil requirement from third-level carriers. At the time of this project,

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[120]One interesting case that demonstrated the government flexibility in meeting EMBRAER's commercial concerns has been the government accepting the shelving of the fighter project. An example of what could happen if this project had been started was the Israel Lavi fighter program, cancelled because of uncompetitiveness. Although state-owned, EMBRAER has not been required to manufacture uneconomical products [Ref. 5:p. 54].

the civilian airlines needed an aircraft to replace the DC-3. The international market was offering mainly larger turboprop transports and the small carriers began to find it impossible to operate low-density traffic services on a cost-effective basis. A market for an aircraft that better adapted to this type of route and with capacity to operate on unprepared runaways airports was being increasingly expressed, not only in third world countries but also in industrialized nations. Second, the military requirement from the Brazilian Air Force (FAB) was also applicable to some other third world areas. At the same time, the FAB was looking for a replacement for its 7-10 seat Beech C-45 light transport, with a large cabin space. Despite numerous trade-offs which favored the military layout[121], the Bandeirante production and sales success in various versions has proven the value of such dual market planning. Although the initial production was a big risk due to the inexperience of EMBRAER in a monopolized market dominated by industrialized nations, the initial acquisition by the FAB and Brazilian regional airlines opened the way to the international market[122][Ref. 13]. In 1977, after the Paris Air Show, EMBRAER opened the European market[123]. While the European market naturally constituted one of the

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[121]The final design was limited to ten seats in order to comply with FAB requirement. Later, other stretched version were developed to attend civil requirements.

[122]The initial deliveries of the FAB 80 aircraft [Ref. 280], followed by Transbrasil and Vasp (two major Brazilian domestic carriers) and lately by TABA (Transporte Aéreo da Bacia Amazônica - one of the first legally Brazilian regional airline to operated third-level services) changed the unambitious production of 2 aircraft a month to a large-scale production. So, EMBRAER felt itself with capacity to jump for the international market.

[123]This event played a major role in the development of EMBRAER sales. A total of 48 Bandeirantes were sold mainly to France, U.K., and Australia [Ref. 13].

Brazilian manufacturer's aims, outlets in the U.S. were without question a primary target for the Bandeirante. To ensure maximum impact in the North American marketplace, EMBRAER signed up with Aero Industries of Los Angeles as U.S. distributor in June 1978. The U.S. FAA certification was obtained only on August 18, after a series of frustrations[124]. The first orders came by mid-September and Bandeirante sales reached a number which required EMBRAER to establish a factory support facility in Ft. Lauderdale, Florida[125].

When Bandeirante reaches 500 units sold, it will be substituted by the CBA-123, known as the Bandeirante successor, because production tooling is virtually identical [Ref. 14]. Bandeirante has been continually produced in twelve versions, all designed for specific applications. As a "pioneer", Bandeirante had to overcome a lot of obstacles[126], and set the market for the Brasilia and following commuters, but its survivability has demonstrated the capability of a small aircraft producer in competing in an aggressive market.

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[124]The FAA refused to certify the Bandeirante until an order was placed for it by an American customer, while EMBRAER was unable to sell the aircraft in the U.S. until it had been FAA certified [Ref. 13].

[125]Besides this facility, EMBRAER has opened subsidiaries at Le Bourget Airport Paris, France, and at London to be in charge of the AMX marketing (information from EMBRAER).

[126]The U.S. - Brazil relations in general aircraft trade has been tense. FAA certification, Bandeirante's crashes [Ref. 32], retaliation for tariff and trade barriers, and numerous other problems has been focused in the Brazilian aircraft exported to the U.S.

There were various other market success and failures. The following descriptions emphasize the market evolution of EMBRAER through their different indigenous models[127].

- **EMB-201 IPANEMA**[128] - This agricultural aircraft was developed following Ministry of Agriculture specifications. Over 500 aircraft were produced and are in operation in Brazil, Bolivia, and Uruguay. The production was transferred to Neiva in the second half of 1981 [Ref. 15:p. 14].

- **EMB-121 XINGU**[129] - The production started in 1977. It was the first pressurized aircraft ever built in South America. However because of the Brazilian government economic measures against inflation, freezing credit and funding requests, the domestic market was paralyzed. The same lack of success was found in the international market. Through the end of 1983, about 100 Xingus was delivered, including 41 to France for military training and liaison.

- **EMB-120 BRASILIA**[130] - This 30-seat pressurized aircraft occupies the highest priority among the commercial projects at EMBRAER because it exists in a much more crowded market. The main competitor is the Swedish Saab-Fairchild's 34-seat SF-340. EMBRAER is forecasting that a minimum of 400 will be sold in a production program that could last as long as 12 years [Ref.14]. Twenty-six customers in 13 countries by May 1988 have placed orders or options for 295 aircraft [Ref. 8:p. 12].

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[127]The Piper models, AM-X, and Paraná cases will be covered in Chapter Five. The information about the following aircraft came from Jane's All the World's Aircraft [Ref. 15] and various other specialized periodicals.

[128]Design started in May 1969 by IPD-CTA and transferred to EMBRAER in January 2nd, 1970. The first flight was in July 30th, 1970, and certification in December 14th, 1971. A total of 600 Ipanema have been produced and sold [Ref. 15].

[129]The first flight took place on November 16Th, 1976. The production started in 1977 and the certification occurred in mid-1979 [Ref.12 : p.18].

[130]Design started in September 1979, initial flight on 27 July 1983, certification by CTA in 10 May 1985, first customer Atlantic Southeast Airlines (USA), scheduled production rate is four per month. Its primary name was Araguaia [Ref. 13].

- **EMB-312 TUCANO**[131] - This aircraft was designed in the late 1970s to meet Brazilian air force specifications for a new high performance trainer to re-equip its fleet of aging Cessna T-37s. Today it has become very successful[132]. It is a single motor turboprop trainer aircraft that can also be equipped with 1000 kg of armament for tactical support functions, filling a segment in the international market somewhere between a beginner trainer aircraft and a more complicated jet. The FAB ordered 118 with an option to buy 50 more [Ref. 8:p. 13]. Tucano burns 30% less fuel, can reduce indoctrination time in a typical training syllabus by 20%, and it is priced below its nearest competitors. EMBRAER has given licensed production of this aircraft to Short Brothers (North Ireland) and Arab Organization for Industrialization - AOI (Egypt) in offset for large aircraft acquisitions for the U.K. Royal and Egypt air forces[133][Ref. 5:p. 53]. Tucano deliveries then totalled 349 out of 467 firm orders; options were held for a further 125 [Ref. 8].

(4) Technology Strategy

EMBRAER basic technology strategy has been followed two basic approaches[134]. First, it has used a series of R & D institutes to develop new products, train its employees, and improve government technology transferred by the CTA. Secondly, it has acquired technology from foreign firms when rapid acquisition has been necessary. The first approach was expressed by indigenous designs, manufacturing, and production (e.g., Bandeirante and Ipanema were developed by CTA and passed to EMBRAER to be improved and commercially produced). At the beginning it was reserved to CTA as an important task to

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[131]Design began in January 1978, first flight on the 16 August 1982, production rate was 4-5 per month in 1987 [Ref. 8:p. 13].

[132]EMBRAER has been using strong sales promotion efforts such as advertising and impressive demonstrations by the air force aerobatics team Esquadrilha da Fumaça (Smoke Squadron) [Ref. 8:p. 13 and 9:p. 27].

[133]The Egyptian government ordered 120 (40 for its own air force and 80 for Iraq) with options on 60 more, of 20 would be for Iraq. The Royal air force ordered 130 aircraft with special requirements [Ref. 8].

[134]Moxon [Ref. 1] clearly identified these two approaches in his study.

develop both civil and military products. As the company became technologically self-sufficient, EMBRAER started to design and develop the civil-related products, leaving the CTA with more advanced or experimental work. Today, EMBRAER is the main organization doing R & D in the aircraft field[135] and the CTA has been concerned with the certification of aeronautics products and quality assurance, in addition to the development of the space program. The second approach indicates that in addition to the indigenous R & D, EMBRAER has been acquiring considerable foreign technology using various joint-ventures with different countries. In 1970, EMBRAER got its first license from Aermacchi (Italy) to produce the Xavante jet trainer which allowed the company to developed valuable design and production technology considering its technological level[136]. In 1973, under a subcontract arrangement with Northrop as an offset for the purchase of 42 F-5E by the Brazilian air force, EMBRAER acquired significant technology through the production and assemble of wings pylons and vertical fins and the honeycomb and metal bonding techniques[137]. In 1974, EMBRAER signed a licensing arrangement with Piper, which did not seem to have contributed to improving the technological level of the company. The pressure was on EMBRAER to begin immediate production of planes for a booming market without incurring development costs.

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[135]In 1985, EMBRAER was ranked as the second Brazilian industry in R & D investment [Ref. 31]. Its Technical Department has about 1300 employees (scientists, engineers and technicians).

[136]EMBRAER at that time only was developing Bandeirante and Ipanema.

[137]These last chemical welding process are commonly used in the production of supersonic aircraft. Under the same contract, Metal Leve S.A. was subcontracted to produce the aircraft's control and bomb rack [Ref. 9:p. 19].

It was clear that a marketing objective was taking priority over a significant technology transfer interest. In 1983-4, EMBRAER signed a technology transfer agreement with Sikorsky to acquire composite materials technology such as Kevlar and Nomex, which are used in various EMBRAER production aircraft. In April 1984, EMBRAER announced that it will nationalize the landing gears that it imports from Eran of France. EMBRAER once more set up a subsidiary, EMBRAER Equipment Division (EDE) to accomplish this task in more efficient way. The last agreement and way to acquire technology has been through the AMX program, although the benefits are unclear as to how much airframe, avionics, and engine design, development, and production technology is being transferred to EMBRAER. This short evolution in the technology transfer approach demonstrated that the company has been used a "steping-stone" approach, establishing a synchronized equilibrium between technology needs and capacity and funds available. Another evolution has been with respect to type of contract, from licensed assembled and production agreements, subcontract and technology transfer agreements, and then to coproduction, as the level of technology transaction increased. It is not an easy task to recognize the benefits of the above transfers in indigenous models but it is evident that much of the technology transferred was absorbed and transformed through R & D and finally applied to indigenous models such as Bandeirante, Ipanema, Xingu, Brasilia, and Tucano, and certainly will be applied in new projects as Paraná (CBA-123) and EMB-145[138].

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[138]This last project was announced in 1989 during Le Bourget Aerospace International Fair. The new aircraft will accommodate 45 passengers and will cost $11 million. The resources to develop the airplane are being obtained from clients,

b. Helicópteros do Brasil S.A. (HELIBRAS)

Brazil has not been successful in lessening dependence on foreign helicopters. The first initiative to establish a helicopter industry in Brazil curiously did not come from the Aeronautics Ministry. In early 1970's, in response to plans of modernization, the Brazilian Navy opened a bid to purchase 35 helicopters. At that time, Aerospatiale from France, Bell from the U.S. and Augusta from Italy each submitted a letter of intention to manufacture helicopters in Brazil. The Aeronautics Ministry favored the French proposal, but was unwilling to invest in this new project. EMBRAER offered itself as a partner, but was overloaded with other projects at that time. This bid was delayed until 1977, when finally the government officially approved the proposal[139]. Under this agreement, the French company was required to initially supply all parts and components of the system and progressively transfer technology without payment of royalties [Ref. 9:p. 21]. At the same time, Helicópteros do Brasil S.A. (HELIBRAS) was formed and jointly owned

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suppliers, bankers, investors, and EMBRAER. It will have a short development because is an enlarged version of the EMB-120 Brasilia (75% of the parts) [Ref. 16 and 17].

[139]According to some sources, the French government's purchase of EMBRAER's Xingu aircraft, in later 1983, was linked to this approval. It means the Xingu sale was connected as an offset for the acquisition of the helicopters.

by Aerospatiale from France (45%), Aerofoto Cruzeiro do Sul (10%)[140], and the government of Minas Gerais state (45%)[141].

As an offset for this first contract, HELIBRAS has been assembling Aerospatiale SA315B LAMA (called HB315B GAVIAO in Brazil) and AS350B and AS350B1 ECUREUIL (called HB350B ESQUILO in Brazil) single-engined helicopters and later the company also started assembling the twin-engined AS355F2 ECUREUIL[142]. Throughout the entire contract, general government dissatisfaction with HELIBRAS and Aerospatiale existed due to the constant delay of the French company's schedule in delivering the knocked-down parts and because of the short amount of local content in its helicopters[143]. As a result, the production, expected to total 200 units over ten years since 1979, was delayed and

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[140]This private company had extensively used Aerospatiale helicopters. Later it dropped out and sold its shares to the government of the state of Minas Gerais.

[141]The company is located in Itajubá city in Minas Gerais state. After the acquisition of the Aerofoto shares, the government of Minas Gerais, in 1982, sold 4% with an option of other 47% of the shares to Construtora Mendes Junior (a large construction firm) that took over management of the company. However, 12 months later, Mendes withdrew and sold the shares back to the state. Finally, in 1987, the state government of Minas Gerais gave up its holding the company; the new major shareholder is the Brazilian armored vehicle manufacturer ENGESA (Engenheiros Associados SA).

[142]These helicopters have been manufactured with some local modifications and a limited number have been exported to Bolivia (11), Venezuela (3), Paraguay (5), Argentina (1), and Chile (1) [Ref.8 : p.15]. The military version of HB350B ESQUILO includes artillery support, SAR, training, transport , and observation [Ref. 18].

[143]The local production of knocked-down kits was expected to build up from 27% by 1980 to approximately 70% by 1983.

costs were running above international levels. Less than 70 units had been assembled by 1984, with no local technology input [Ref. 1:p. 190].

In January 1985, the Aeronautics Ministry opened another bid to purchase large helicopters. Although dissatisfied with HELIBRAS and its parent company Aerospatiale, the Brazilian government decided to buy 25 SA330 SUPER PUMA for the Air Force (15) and Navy (10), and 15 ESQUILOS for the Navy, but this time all were made and assembled in France[144]. It was reported that besides very favorable financing offered by the French, Aerospatiale had agree to purchase a number of EMBRAER Bandeirantes in offset[145] [Ref. 1:p. 191].

In February 1988, the Brazilian Army once more selected Aerospatiale as the winner of that service's helicopter bid. The Brazilian Army bought 52 antitank and assault helicopters for its first airborne cavalry unit. This last contract value of $260 million involves an offset agreement and will be discussed later on the Aerospatiale case.

c. Companhia Eletromecânica Celma (CELMA)

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[144]It was reported that EMBRAER had called for the dissolution of Helibras and had negotiated for the establishment of a new helicopter joint venture with Sikorsky who submitted a proposal in February of 1984. The other company also involved in this second bid was Bell Aerospace Textron Co. The EMBRAER/Sirkorsky agreement for composite materials technology was supposed to be the basis for this agreement but once more, Aerospatiale won.

[145]This demonstrates the versatility of EMBRAER. Whichever contract was chosen by the Brazilian government, EMBRAER was prepared to win, even indirectly.

There were many failed attempts to establish an aeronautical engine manufacturing company in Brazil[146]. The creation and improvement over time of maintenance shops by VARIG, ROLLS ROYCE DO BRASIL, and CELMA was considered a definitive step towards the creation of a comprehensive national engine industry.

CELMA, a private manufacturer of vehicle chassis and domestic appliances, was purchased in 1957 by Panair do Brasil, a subsidiary of Pan American World Airways, and turned into an engine repair facility. In June 1972, when Panair went out of business, CELMA became part of the Aeronautics Ministry, that holds 80% of the shares leaving 12% for Pratt & Whitney and the remaining for other minor shareholders.

CELMA is located in Petrópolis, Rio de Janeiro state. It employed over 1400 in 1989, in an area of 35000 sq mt [Ref. 8]. It overhauls GE and Pratt & Whitney engines and repairs engine parts. Most of its services are for the Brazilian Air Force and regional airlines.

CELMA has recently upgraded significantly its engine maintenance and repair capabilities under a joint investment program with GE and the Brazilian government. It has sophisticated parts repair capabilities, using advanced processes such as plasma spraying, electroforming and electron beam welding.

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[146]The government, through the CTA, began pushing engine production in the 1970's, but again found the same obstacle; a limited market needing large scale production. Both Lycoming and Pratt & Whitney PT6, used in aircraft manufactured by EMBRAER, were found to be uneconomical.

With the AM-X coproduction agreement with Italy, the Brazilian government took a share of the production of the fighter Rolls-Royce engine MK-807 Spey. CELMA is to produce twelve components, assemble, test, and overhaul this engine, performing 22% of the man-hours required for the production of the complete engine. The Project Spey will be analyzed within the AMX case.

C. SPACE AND MISSILE INDUSTRIES

Brazil's space industry has played an essential role in the overall aerospace industry growth. Under an ambitious space program with numerous technology transfer barriers and financial constraints, Brazil is working in three main directions: telecommunications, remote sensing, and launch capability. Despite Brazil's enormous area and population, its population is concentrated mainly in urban centers along the Atlantic coast. This has created two different countries within the same country. On one side it has an industrial region with a complex society engaged in productive activities. On the opposite end of this socioeconomic spectrum, is a rural region struggling to overcome severe economic limitations. The difficulties that affect the development of the interior are complex, and they are getting worse with the lack of communication between a distant Amazon region and the overcrowded, industrial Southeast cities. One means of overcoming these communications barriers has been the development of satellite telecommunications.

In the early 1970s, various Brazilian government agencies and industries started working in telecommunications and space programs to develop a Brazilian

industry capable of connecting all points of the country[147]. Various problems such as the energy crisis and the lack of technological and financial capabilities have resulted in the Brazilian government engaging in alternative programs. For example, the Ministry of Communications created the Sistema Brasileiro de Telecomunicações por Satélite (SBTS) to give more flexibility in the communications services. As a result, numerous earth stations and ground terminals were spread all over the country; transponders from INTELSAT were leased; and as the requirements increased, communications satellites were acquired to form an independent system. But even with these efforts, the space program continues with its mission to develop indigenous satellites and launch vehicles and to launch them from domestic launch bases. The hope is that some day in the future, this second important part of the Brazilian aerospace industry will find its "commercial" way as some products from the aircraft industry did.

As a consequence of the technology development and spinoffs, an indigenous missile industry is being created that already develops short and medium-range ballistic missiles. A critical point of this discussion is the link between the space industry, with non-belligerent motives, and the ballistic missile industry, which seems to have the same outcome[148]. This section condenses each

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[147]The Brazilian Telecommunications industries are represented mainly by TELEBRAS (Telecomunicações Brasileiras S.A) and its subsidiary EMBRATEL (Empresa Brasileira de Telecomunicações) both under the Ministry of Communications control.

[148]This point focuses on BRASILSAT as the "crucial case" of this research. Prof. Tollefson (NPS - National Security Affairs Department) assisted this part with his expertise and research material.

of the above activities into three parts: the space program which includes BRASILSAT program, the missile industry, and the technological barriers which are the background for the BRASILSAT case that will be discussed in Chapter Five.

1. The Space program

Despite the numerous technical, political and financial problems, Brazil's space program, called Brazilian Complete Space Mission, Missão Espacial Completa Brasileira - MECB, continues to be the most ambitious in South America[149]. This extensive program, in its original concept, included the construction of four flight satellites; design, development and construction of a launch vehicle system; construction of a launching base and a tracking network; and development of a modern data processing capability [Ref. 19:p. 75].

The MECB program implementation responsibility is shared by two different government agencies based on military and civil objectives. The military part is subordinated to the Aeronautics Ministry and the civilian part is subordinated to the Science and Technology Ministry. Each part has its own missions and objectives. However, both parts are coordinated by a joint military-civilian committee, the Brazilian Commission of Spacial Activities - Comissão Brasileira de Atividades Espaciais - COBAE, that is responsible to establish guidelines and policies in space-related issues[150].

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[149]The program cost estimate is about $1 billion [Ref. 19:p. 75].

[150]Although the division of labor is well defined, the military part is predominant. The president of the COBAE is the armed forces chief of staff. The COBAE is directly subordinated to the President and comprised by a group of ministries [Ref. 20].

The Aeronautics Ministry directs the development of the construction of the launching base and the satellite launch vehicle, Veículo Lançador de Satélites (VLS). Both programs are under the direction of the CTA. The **launching base program**, called Launching Center of Alcântara - Centro de Lançamento de Alcântara (CLA) is being constructed in Alcântara, a small city located in Maranhão state, 35 km from the capital, São Luis. The implementation is administered by the Alcântara Launching Complex Group - Grupo de Implantaçao do Centro de Lançamento de Alcântara - GICLA[151]. This site was selected because of the meteorological conditions, the position with respect to sea level, and the proximity to the equator (2 degrees and 18 seconds)[152]. The **VLS program** is developed by the CTA under the Space Activities Institute, Instituto de Atividades Espaciais - IAE. The program, denominated SONDA, has been using a stepping-stone approach based on four series of sounding rockets. More than 200 SONDA rockets have been fired, mostly for weather data such as temperature and winds [Ref. 19:p. 77]. Since November 1984, there have been at least five firings of the last stage rocket called SONDA IV, that is a 11 meter rocket weighing 7.3 tons and has some 3000 components, of which 70% are locally purchased[153] [Ref. 23]. Table 4 shows the evolution of the SONDA program. The VLS will be a four-stage, solid fuel launch

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[151]In October 1987 it was reported that 1200 workers of two construction companies, Andrade Gutierrez and Mendes Junior, were working hard to complete the schedule because the first VLS launch was scheduled for 1989. This base is supposed to be completed now [Ref. 21].

[152]According to specialists this site permits maximum tangential speed, allowing for a substantial saving in rocket fuel (about 25% savings) [Ref. 21].

[153]The first prototype SONDA IV was launched in November 1984 [Ref. 22].

vehicle powered by four SONDA IV[154] boosters. The test-launches of the SONDA series have occurred in Barreira do Inferno launch base that is located in the extreme northeast, near Natal. The VLS was due to be ready in 1989 based on the original timetable, but the first flight has been postponed until 1992 [Ref. 25].

The civilian part of the MCEB program is administered by the Brazil's Institute for Space Research, Instituto Nacional de Pesquisa Espacial - INPE, also located in São José dos Campos[155]. It is responsible for the design and construction of satellites[156]. The other activities of this agency include space and atmospheric sciences, space engineering and technology, and space applications.

2. BRASILSAT Program

Not all developing countries have the same degree of development in space technology. Some of them already have the missile technology and have put satellites in orbit, using a national launch pad[157]. Brazil has been searching for an opportunity to get into this small club, called the "space powers". The

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[154]The VLS is 19 meters, weighs 50 tons, and carries 40 tons of solid fuel [Ref. 24].

[155]In 1984, INPE had approximately 1400 employees of which 80 were employed with doctor's degrees, 150 with master's degrees, and 400 with bachelor's degrees [Ref. 20]. In February 1989 it reported 1707 employees [Ref. 26].

[156]Some sources indicate that the first satellite, the Data Collection Satellite, SCD-1, has already been constructed. The contrast in deadlines between INPE and CTA resulted in the firing of the INPE head, Marco Antonio Raupp, who insisted that Brazil should contract just the services to launch the domestic satellites instead of waiting until 1992. This position was opposed completely by the Aeronautics Ministry that had incorporated INPE after the dissolution of the Science and Technology Ministry [Ref.26].

[157]China and India are developing space programs similar to Brazil.

TABLE 4

SONDA ROCKETS

	Sonda I	Sonda II	Sonda III	Sonda IV	VLS
Type	SS/SF	SS/SF	TS/SF	TS/SF	FS/SF
Payload (lbs)	9	97	130/310	1,100	330-440
Launch Wt (lbs)	130	795	3,485/3,350	16,000	108,050
Altitude (mi)	40	55	370/155	400	220x340 mi polar or circular equatorial orbit
First Launch	1965	N/A	1976	1984	1992 (est)

S = single stage SF = solid fuel TS = two stage

Source: Shuey, Robert D., "Missile Proliferation: Survey of Emerging Missile Forces", Congressional Research Service, 3 Oct 1988.

BRASILSAT program is one of the Brazilian space strategic plans to reach this objective. BRASILSAT is one part of the MECB entire program and it consists of launchingcommunications satellites in geosynchronous orbit as the spaceborne segment of a system to provide television, telephone, telex and data transmission [Ref. 19].

Originally, the general space plan involved the design and construction of four flight satellites to be launched by the VLS. However, due to numerous technical problems, Brazil has delayed the construction of the first satellite until 1989, and has still not accomplished the VLS, rescheduled for 1992.

What has the Brazilian government been doing in the meantime to overcome these telecommunications problems? The first Brazilian option was leasing spare capacity from INTELSAT. The second option was the acquisition of the foreign made satellites and respective launch services from other countries. The cost and benefits of these options is not the objective of this thesis, but for various reasons, the Brazilians were not satisfied just with the leasing option.

In 1976, the Brazilian government opened the first bidding process and had France's Matra involved as an European MESH consortium, but due to financial problems, the project was shelved [Ref. 39 and 40]. In 1981, Brazil reopened the bid and had Aerospatiale, and Canadian Spar competing for the satellites and Arianespace and Ford Aerospace competing for the launch service. In 1982, the Brazilian government decided to sign a $131 million contract with Spar

for the acquisition of two satellites and their respective launch services[158][Ref.41]. Spar at that time had a license agreement with Hughes (U.S.) to produce the spin-stabilized craft of the HS 376 variety[159]. The offset package asked for by the Brazilian government seems to include training in the launch operation and communication of the satellites [Ref. 20]. The package deal consisted of training EMBRATEL personnel in the ground base station of Guaratiba, close to Rio de Janeiro, and also inside the Spar plant [Ref. 33]. Spar worked with TELEBRAS in the design, development, manufacture and servicing of the systems for the aerospace communications defense aviation and mapping [Ref. 34].

The first satellite (BRASILSAT I) was put in orbit on February 8, 1985 on a V12 Ariane rocket, launched from ELA1 Kourou, Guyana. The second satellite, scheduled for August of the same year, was delayed up to March 26, 1986 due to the V15 third-stage failure in September of 1985. The second launch (BRASILSAT II), involving also the G-STAR II Arabian satellite, was made on a V17 rocket in a brand new ELA2 launch complex, also in Korou [Ref. 27]. Some rumors at this time indicated that the Brazilian government did not include insurance for this second satellite because the premium was 50% of the value of the satellite. As time passed, difficulties in the space program have continued. The supposed failure of the SONDA IV and numerous other technical problems have delayed the entire

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[158]Spar was the main contractor and also provided the launch services through Arianespace, France. It was also reported that Aérospatiale and Ford Aerospace were competing jointly [Ref. 41].

[159]There is evidence that Hughes participation in the construction of these satellites was about 32%.

program. The satellites, although completed, for political reasons will remain waiting for the VLS. So, because of the need to replace the BRASILSATs I and II in 1995 and 1996 respectively, the only option was to invite new bidders for the second generation of domestic communication satellites. This was done in February 1989, and constitutes the case that will be analyzed in Chapter Five.

3. The Missile Industry

According to Agusto Calton, Brazil's missile development program and industry are still small and not engaged in large-scale production. However, he also pointed out that several small and isolated projects may soon become big programs, depending on the decisions by the armed forces [Ref. 28]. Most of the missile technology has been developed indigenously by the two main research institutes of the Army (CTEX) and Air Force (CTA). The development of missiles with domestic technology is due more to constraints in accessing foreign technology than in aiming for self-sufficiency. As the CRS study points, the development and testing of these missiles is probably constrained by lack of key foreign-made components and perhaps by insufficient testing of the short range systems on which the bigger missiles are based [Ref. 29:p. 88].

Two main Brazilian companies have engaged in the production of missiles and have already presented missile projects to the Armed Forces Joint Command, which has coordinated all missile development and production in the country since 1986. A brief description of each industry is given, and their main missile projects are described below.

a. *AVIBRAS AEROSPACIAL S.A.*

AVIBRAS has several facilities around São José dos Campos that represent a total area over 13 million square meters of floor space, employing more than 5000 people. The group has three subsidiary companies: TECTRAN S.A., TECTRONIC S.A., and TRANSVIP S.A. Defense products include rocket engines of several calibers, a wide range of single and multiple charge warheads and fuses, self-propelled and towed-driven multiple launchers, and short medium, and long-range systems for the ASTROS II (Artillery Saturation Rocket System) multiple-rocket-launching systems (with SS-30, SS-40, and SS-60). Its electronic antiaircraft system is called FILA (Fighting Intruders at Low Altitudes)[160]. Its air-to-ground defense systems include twin machine-gun pods for light aircraft, several types of reusable and disposable rocket multiple launchers, and general purpose, incendiary, and special applications bombs. Its surface-to-surface missiles include the Barracuda (SM-70) anti-ship missile, an Exocet type. The company's conceptual project is an anti-aircraft missile named SOLAR by the Army[161]. AVIBRAS is also at the heart of the Brazilian space program building the SONDA line rockets. It is developing a series of missiles (the SS-150, SS-300, and SS-1000 with ranges of 150, 300, and 1000 km respectively). They are perhaps the most important ballistic missiles being developed in Brazil today. The SS-300 missile is

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[160]AVIBRAS, for the first time, purchased technology to implement the Brazilian Air Forces' air defense program. In order to develop the FILA fire control system, AVIBRAS approached the Swiss company Contraves, to adapt SKYGUARD technology [Ref. 18].

[161]Some specialists said that this missile is very similar to the Roland, of which the Army bought four for instructional purposes [Ref. 30].

based on solid-fuel SONDA IV rocket, with an indigenously designed inertial guidance system. AVIBRAS is hoping to achieve extreme accuracy, precluding the requirement for a nuclear warhead[162].

b. ORBITA SISTEMAS AEROSPACIAIS S.A.

ORBITA was created in February 1987 to coordinate Brazil's missile program[163]. It is owned by Engenheiros Associados - ENGESA (40%), EMBRAER (40%), Engenharia de Sistemas de Controle de Automação - ESCA (11%), Indústria de Material Bélico do Brasil - IMBEL (5%), and Participações e Consultoria - PARCON (4%). Initially ORBITA was developing guided missiles as well as rockets and satellite launchers for the space program. However, the Army and Air Force have transferred to them some missile projects developed inside their research centers.

ORBITA has four simultaneous missile projects. The first, namely LEO, will be an anti-tank, laser guided missile based on Italian technology from OTO MELARA company and is being developed for the Brazilian Army[164]. The second project includes British Aerospace for the production of a missile incorporating technology used in the Thunderbolt. The Brazilian version (MSA-3.2)

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[162]Sources reported that some Middle East countries such as Libya and Iraq are may be even partially funding the program to develop it [Ref. 35 and 36].

[163]This company was created to overcome Brazil's armed forces frustrations with delays in the development of self-guided missiles. After a secret meeting in June 1986, a consensus was reached that standardization was necessary in missile production.

[164]The Italian missile MAF will be produced under license. The official Brazilian denomination is MSS-1.2 but is known as LEO in honor of the Army Minister, General Leonidas Pires Gonçalves.

will be in the Mach 3 class but it's likely to be extremely agile, possibly incorporating British thruster and television guidance technology. The third project is the MAA-1 (called MOL in honor to the Aeronautics Ministry Brigadier Moreira Lima) air-to-air missile, originally developed by the CTA research program called PIRANHA. It is an infra-red, thermal-attracted air-to-air missile for "dog fight" combat designed under contract for the Aeronautics Ministry to fit the AMX and its other fighters. The last project, the MB/EE-150 and maybe the most important, had been under development by Engemissil, a subsidiary of ENGESA. It is a mobile tactical missile, fired from a dual launcher chassis, and capable of carrying a 500 kg warhead to a range of 150 km. This missile generated a family of other missiles such as the MB/EE-350, the MB/EE-600, and the MB/EE-1000 with ranges of 350, 600, and 1000 km, respectively.

As was demonstrated, ORBITA and AVIBRAS are the two main Brazilian missile producers. The first one has significant experience using its own technology, but shows an increasing need for more advanced technology through technology transfer. The last, a complete new industry, owned by two other "big ones", acquired most of the its technology abroad to become more competitive than AVIBRAS. Both companies are now competing with each other for government projects, especially those that include tactical missiles.

4. Technological Barriers

This subsection discusses the "Missile Technology Control Regime" (MTCR), a very current topic that has been discussed in lots of newspapers and magazines and is related to transfer of missile technology to Brazil[165].

The MTCR is a policy aimed at limiting the proliferation of missiles capable of delivering nuclear weapons. It was announced in April 16, 1987 by the governments of the United States, Canada, the Federal Republic of Germany, France, Italy, Japan, and the United Kingdom. This MTCR, although neither a treaty nor an executive agreement and with no new organization formed to administer it, establishes strict guidelines to limit the transfer of certain missile-related technologies while preventing commercial advantage or disadvantage for any of the agreeing countries[166].

The reasons for the emphasis on restricting the proliferation of missile production technology originate with the existing restrictions under some of the U.S. regulations[167]. Basically they point out that missile technology (in the form of products or know-how), purchased ostensibly for civilian purposes through normal civilian export licensing, could lead to a recipient country's development of a nuclear-capable missile system.

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[165]The following discussion is based on Frederick J. Hollinger's article, "The Missile Technology Control Regime: Major new Arms Control Achievement", ACDA World Military Expenditures and Arms Transfers, 1987, Washington DC [Ref. 37].

[166]It is emphasized that these guidelines are not intended to impede international cooperation in the peaceful use of space-related and other modern technology, nor are they directed at any country or set of countries.

[167]These restrictions are guided by the Arms Export Control Act (AECA).

All items to be controlled are detailed in the Equipment and Technology Annex to the Missile Technology Guidelines issued by the seven countries in April 1987. Specific items to be controlled are divided in two categories. **Category I** items are those of the greatest sensitivity[168]. It includes complete rocket systems (ballistic missile systems, launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones, and reconnaissance drones) as well as special facilities for these systems. Also covered are certain complete subsystems, including solid or liquid fuel rocket stages, reentry vehicles, solid or liquid fuel rocket engines, guidance sets, thrust vector controls, and warhead safing, arming, fuzing, and firing mechanisms[169]. **Category II** includes propellants, structural materials, flight instruments, avionics, guidance and control components, and test equipment and facilities[170].

Major world powers suspect that Brazil is developing medium and long-range ballistic missiles to deploy nuclear payloads. This has created a lot of concerns from the U.S. government, resulting in a U.S. refusal to transfer technology used to continue the development of the Brazilian VLS. The U.S. suspects that the technology used to make the rocket could be used to

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[168]Most of the export licenses for these items will normally be denied and when exceptions are applied, there will be appropriate assurances against misuse.

[169]Controls are placed on guidance systems capable of achieving system accuracy of 10 kilometers or less at a range of 300 kilometers. Guidance systems designed for short-range missiles (less than 300 kilometers) or manned aircraft are exempt.

[170]These items may be approved at the discretion of each partner in the regime, depending on a variety of factors including stated end-use.

manufacture a medium-range ballistic missile capable of carrying an atomic bomb or other chemical and biological weapons[171]. The other related reason is Brazil's "pragmatic" foreign policy and aggressive arms sales that could enable non-allied countries such as Libya to obtain this kind of weapon[172].

Although the U.S. boycott has been carried out with the leading industrialized countries through the MTCR, the French have not been so inflexible and have been maintaining a large space cooperation program with Brazil[173]. The BRASILSAT case is an example of this French cooperation though it has not been without restrictions[174].

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[171]Some specialists pointed out that the first series of the Brazilian rocket SONDA has been the basis for AVIBRAS to develop its ballistic models for military use [Ref. 29:p. 92].

[172]The U.S. has used the recent example of India to justify the ban on the "proliferation" of ballistic missiles in the Third-World. On 22 May 1989, the Indians launched the Agni ("fire"), a ballistic missile with an estimated range of 2500 km. India has also constructed satellite launch rockets using the same basic technology [Ref. 25].

[173]For example, the Brazilian launch base at Barreira do Inferno is helping with the flight control of the Ariane rockets launched from Korou in French Guiana [Ref. 25]. Brazil charges the pittance of $100,000 for each launch tracking. This base is also being used to launch experimental rockets for the FRG [Ref. 22].

[174]France has not issued a blank check for the transfer of technology. Some specialists inside McDonnell Douglas point out that France is offering at least 25 year-old technology in offset for launch services [Ref. 38].

V - BRAZILIAN AEROSPACE OFFSET CASES

This chapter analyzes the Brazilian aerospace offset cases in four main types. A background about the existing theory of each type of offset is described in Chapter One. The four sections are:

A. COUNTERTRADE (MD-11 aircraft)

B. TECHNOLOGY TRANSFER (BRASILSAT program)

C. LICENSED PRODUCTION (PIPER and AEROSPATIALE)

D. COPRODUCTION (CBA 123 aircraft and AMX program)

The following sections will cover specifically the case analysis within the framework already established in Chapter Two. For each of the independent variables a grade will be attributed ranging from **low** to **high** impact on the dependent variables (outcome). The outcome will be obtained according to the combination of factors explained in Tables 1 and 2 in Chapter One. A **medium** grade will be attributed when there will be a balance between the positive and negative impacts. When the information is not available to answer the question, the term **unknown** will be used. When the analysis of the variable does not make sense, the term **not applicable** (**N/A**) will be used as an answer. At the end of each case, there will be a table which resumes the case results. A comparison of the cases will be drawn in the Chapter Six, where the hypothesis will be tested.

A. COUNTERTRADE

This section provides an example of Brazilian government utilization of countertrade in an acquisition of civilian aircraft for Brazilian airlines. The term countertrade, as defined before, encompasses various types of commercial arrangements such as barter, counterpurchase, and compensation (or buy-back) in which a supplier commits himself to take products from a recipient country in full or partial payment. In some countertrade transactions, payments for the goods bought and sold are actually made; in other forms of countertrade, there are no payments at all[175].

1. MD-11 Aircraft Case

The MD-11 countertrade agreement was chosen in order to illustrate the application of the previous established framework to the offset type called countertrade. The case is related to the VARIG Brazilian Airlines acquisition of 10 tri-jet MD-11 aircraft acquisition from McDonnell Douglas. The offset required by the Brazilian government is 10% of the $1 billion total value. This offset has been implemented through a contract between McDonnell Douglas and EMBRAER for the development and production of flaps sets for the same aircraft. Since it is a recent agreement, much of the information had to be collected from personal interviews and telephone conversations with the companies' staffs, and also through correspondence with the Brazilian government offices involved in the offset program.

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[175]This is one important point that should be clarified at this stage. Countertrade is not "trade without money". Only in a few cases of classic barter does this occur; in all other cases money is used.

Q17) What are the offset agreement characteristics?

In March 1987, VARIG Brazilian airlines[176] signed a "letter of intention"[177] with McDonnell Douglas (MCD) for the acquisition of 4 MD-11 aircraft with an option for 6 more for a total value of $1 billion[178] [Ref. 2]. From now on this contract will be called the VARIG contract.

The MD-11 is a tri-jet long range aircraft, with a payload of 25 tons, a range of 12,746 km, and a capacity to transport more than 400 passengers in its high density configuration. However, VARIG planned to operate this aircraft with only 270 seats in three classes [Ref. 2] . The airline company's current plan is to use the MD-11 to expand existing international services [Ref. 5].

In the last half of 1987, MCD signed a contract with EMBRAER for developing and manufacturing composite wing flaps for the MD-11. The contract implied that EMBRAER would supply 200 sets and an option to deliver a further 100 sets at a later date. It was worth $120 million [Ref. 6]. For this analysis, this contract will be called the EMBRAER contract.

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[176]VARIG is the largest airline in Latin America. The company is 79% controlled by its employees, operates a fleet of 84 planes, and has offices in 64 countries [Ref. 1].

[177]This document is commonly used by aircraft manufacturers to assure the market before launching any huge aircraft project. When VARIG signed this letter, 11 other international airlines announced the same intention [Ref. 2]. The launch customer was British Caledonian Airways in December 1986, with 9 aircraft [Ref. 3:p. 466]. In 1988, MCD published that 88 MD-11 orders and 162 options and reserves were recorded between 1987 and 1988, for a total of 250 aircraft [Ref. 4].

[178]This information was confirmed through a personal interview with MCD [Ref. 7].

Both agreement and contract were signed before the Aeronautics Ministry (MAER) had issued the new regulation in December 1988 requiring offset. The real contract, superseding the VARIG's previous letter of intention was signed at the beginning of 1989. Although the EMBRAER contract was awarded in 1987, MCD has been arguing with the MAER to accept this previous contract as a 10% obligation, according to the offset regulation. Chances are that the MAER will accept this MCD proposal, which means that MCD had already fulfilled this offset transaction before the actual sale had occurred[179] [Ref. 7].

Assuming the MCD proposal was approved by MAER, this offset is classified as a countertrade type involving some transfer of technology. It also may be classified as direct (the flaps are components of the same aircraft sold). The 10% percent offset goal was reached ($120 million is more than 10% of $1 billion). The implementation time regulated by the MAER must be up to 10 years, which seems to be more than they need, taking into account the financing arrangements (normally 5 years) for the aircraft acquisition and EMBRAER's schedule for flaps delivery[180]. The method of enforcement applied was "best effort". The VARIG contract was not available for analysis but it does not appear to have any offset clause or "side letter" asking for compensation. Because the aircraft is for civilian application, the EMBRAER contract does not have an "end-user" clause.

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[179]One clause (section 38 - OFFSET/COPRODUCTION) of the EMBRAER contract for the production of the flaps explains that MCD would be credited in the future for any offset requirements [Ref. 7].

[180]The delivery of the first set of flaps was scheduled for August 1987 with the assembly of the first MD-11 commencing in April 1988 [Ref. 8]. Until December 1988, no MD-11 aircraft was delivered [Ref. 4].

Q1) What type of technology is being transferred?

It was not possible to ascertain the type of technological methods and processes transferred to EMBRAER in this agreement. According to MCD managers it was a very "low technology" contract. Once EMBRAER was contracted to develop and produce the flaps, it meant that they already had the technological capacity to perform the job. It is possible that the transfer of a low technology may involve the transfer of specific outboard flaps drawings originating from the MD-11 main project design [Ref. 7]. Each wing flap is 8.9 meters long, with a width ranging from 1.9 meters maximum to 1.29 meters minimum. The flaps are made of carbon-epoxy composites that will achieve a 168 kg weight saving for each set of flaps [Ref. 6 and 8].

Since the technology involved in this contract will improve the overall EMBRAER level of technology in composite materials very little, this variable was graded as low.

Q2) What is the technology transfer environment?

The information collected through interviews indicates that the technology transfer environment is excellent. EMBRAER is considered by MCD engineers to possess the technological capability to develop and produce the flaps with no major quality problems [Ref. 9]. EMBRAER's contract was signed before the Brazilian government had enacted the regulation, and it is likely that the Aeronautics Ministry will credit this contract as a VARIG offset contract.

Based on information collected personally at MCD, this variable was graded as high.

Q3) What are the recipient firm's characteristics?

EMBRAER has been expanding its capabilities to work with new composite materials since 1983, when the company contracted with Sikosky to transfer composites material technology. The company has expanded its molding facilities for composite parts by 10,000 square feet and installed a new autoclave. EMBRAER also installed another $1.5 million autoclave to complement the 15 X 4.5 meters unit currently being used to cure composite parts[181] [Ref. 10].

Because of the recent EMBRAER capacity development in composite materials, balanced with the evidence that EMBRAER was certified as a reliable supplier by the MCD technical department, this variable was graded as medium.

Q4) What are the recipient firm's characteristics?

The MCD subsidiary, Douglas Aircraft Division, is a well known commercial jet manufacturer. It has been producing the DC (Douglas Commercial) series since 1933 and started with the MD (McDonnell Douglas initials) series in 1983 with the MD-80 (derivative from the DC-9). The new MD-11 is an advanced medium/long range successor of the DC-10. The principal marketing characteristics of the company have been to provide offset incentives as a tool to win international competitions. The offset department is prepared to offer offsets ranging from subcontracts for the production aircraft parts to tourism packages in

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[181]Composite materials account for 15% of the EMBRAER Brasilia aircraft along with other lighter materials. These materials have decreased the plane weight by 858 lb, making it the lightest plane of its kind [Ref. 10].

exchange for sales[182]. The MCD technology transfer philosophy may be evidenced through the numerous offset agreements signed mainly with NATO countries for the transfer of high technology weapons. In this case, the company was motivated by the aircraft sales in order to make this project commercially viable and by the lower labor cost offered in Brazil.

In summary, due to major use by MCD of offsets and technology transfer as a powerful marketing instrument not only in the EMBRAER agreement, but in the most civilian and military offset agreements, the value of high is assigned to this variable.

Q5) Will this technology be integrated?

It is very likely that EMBRAER will be able to develop and produce these flaps without major problems. The company owns a relatively high quality assurance division, strictly controlled by the IFI, the Brazilian government agency responsible for certifying aeronautic products using FAA patterns. It seems that in terms of labor skills, the company has a very well trained cadre of engineers and technicians in design and production engineering. The composite material division, although relatively new, has been receiving experienced personnel from the other divisions. The other measures such as time pressure and proportion of service labor in relation are not in evidence. It seems that this division has adjusted its

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[182]This commercial characteristic in using offsets frequently is also applied in the negotiation of military aircraft such as the F-18 deals with Spain, Australia, Canada. MCD currently reported to have some $1 billion in offset commitments which rises annually since 1960 [Ref. 11].

chronogram for deliveries with the aircraft assembly[183], and the proportion of service personnel has been normally managed.

The low technology transferred through this agreement is counterbalanced with the EMBRAER high quality assurance of its products. This variable is graded as medium.

Q6) Does this offset agreement conserve foreign exchange?

This case exemplifies what was described before in Chapter Two as "apparent savings". This countertrade may help the country in exporting more products (in this case flaps) but the real foreign currency savings has not happened because both contracts require cash payments. One alternative to improve the savings is through some kind of credit account that would be established by MCD and could provide some savings in the overall transaction, which would not be that attractive to EMBRAER. For example, VARIG would pay $120 million in cruzados to EMBRAER and the country would pay the $880 million in U.S. dollars, saving $120 million of foreign currency. Although this transaction seems easy, it would not offer advantages to EMBRAER, which would lose money in the foreign exchange processing. Considering that this last alternative would demand several changes in the two contracts already awarded, this variable is graded as low.

Q7) Does this agreement create jobs?

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[183]Assembly of the first MD-11 was planned to begin in March 1988, with the first flight scheduled for March 1989. The first delivery is scheduled in Spring of 1990 [Ref. 3:p. 467].

The information to answer this question is unknown. However, it seems that this contract will support for at least three years a reasonable labor capacity in the EMBRAER composite material department. Today, besides this production, this department has been used to produce some parts in composite materials for the Brasilia aircraft and, in the future, to the AMX fighter. Certainly EMBRAER will not hire more people just to keep this contract on schedule. There is evidence that the company is using three shifts a day of eight hours each in the critical departments, which may include the composites department also.

Despite lack of data to answer this question, the assumptions made lead to an estimated value on this variable of low.

Q8) Does this offset improve exports?

The subcontract to develop and produce outboards flaps for a top advanced aircraft represents a way for EMBRAER to establish a market for components using the composite material technology. This contract would open to EMBRAER a great opportunity to compete technically and commercially with other industries in the U.S. for the supply of components made using this technology. It is really difficult to forecast if it will happen for sure. According to MCD, EMBRAER is considered now by the company as a reliable supplier and future agreements with MCD certainly will occur [Ref. 9]. EMBRAER is concerned about executing their agreements with United States companies, expecting that this strategy will result, in a future medium to long term "two-way street" approach. EMBRAER has been seeking a partner to be more competitive in the U.S. market

with its Tucano trainer, and MCD has expressed interest[184]. Another approach that answers partially this question is the VARIG capacity in exporting its services. With the new aircraft, the company may set up a relevant market and may export better services. This variable is graded as medium because the proportion of offset (10%) is relatively low, but it is balanced with the future benefits in opening the export market.

Q9) Does this agreement enhance the financial viability of the project?

Both the VARIG and EMBRAER contracts are using financial arrangements but they are considered separately, without any financial link. It means that countertrade, if accepted by the MAER, will not add any financial benefits beyond the previous arrangements. The EMBRAER contract does not include any foreign direct investment by MCD, either. This variable is graded as low because the countertrade, even considering the terms accepted by the MAER, will not result in any financial benefits, in the case of both the EMBRAER and VARIG contracts.

Q10) What are the internal and external political motivations for this agreement?

The main internal motivation found in both the VARIG contract and the EMBRAER contract is found in the Aeronautics Ministry department called DAC. This department is now responsible for coordinating the Subcommission of

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[184]In interview at MCD, it was mentioned that a possibility exists for MCD and EMBRAER to be allied to win the USAF and US NAVY bid for the substitution of the Fairchild T-46 jet trainer [Ref. 9 and 13].

Commercial Compensation (SCC) activities. The MD-11 case is estimated as one of the first applications of the regulation enacted in December 1988. Even if the MAER considers the EMBRAER contract as an offset credit and misses the opportunity to require 10% compensation from MCD, it is believe that the contracts will be beneficial in future negotiations with U.S. aircraft manufacturers. The initial difficulty is to develop a way of thinking about offset. It is difficult to convince companies such as VARIG of the overall benefits of this policy and to require this company to include the offset clause in its acquisition contract[185].

Because the motivation to have the offset program implemented starting with this agreement only came from the Aeronautics Ministry, and seems to have been supported by the other government sectors, this variable is graded as low.

Q11) How does this government act in this offset?

This case is the first identifiable opportunity that the Brazilian government has had to implement its offset policy at least for the acquisition of large commercial jets. The government has been controlling the acquisition of foreign aircraft since 1974, not only to protect the domestic industry, but to control the volume of aircraft and the safety and maintenance requirements[186]. The government also has actively supported the negotiations in a second phase, basically on the

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[185]The buyer company (e.g., VARIG) always has the impression that this clause will harden the negotiation, with the supplier increasing the price of the contract to cover the administrative costs of these offsets. There is no evidence that this has occurred in this case but many offset specialists have pointed to this drawback for recipients.

[186]The COTAC requirements to have the petition approved include the aircraft fabrication date and maintenance facilities that will be used [Ref. 12:p. 32].

offset clause arrangement discussions. It seems that the new Subcommission of Commercial Compensation (SCC) will be responsible for controlling the offset fulfillment. But for this case, it seems that this department is still waiting for a major decision from the government as to whether it will consider the EMBRAER contract as the offset for the VARIG contract. Perhaps after this definition, SCC may implement some of the fulfillment controls.

The government participation in this agreement has been effective in establishing regulations requiring offsets, being an active negotiator, and setting up some government departments responsible for managing this type of special offset agreement. On the other side, this Aeronautics Ministry movement has been isolated and autonomous instead of an integrated governmental action. Because of this duality, this variable is graded as medium.

Q12) What are the political and social pressures of this agreement?

The evidence of political and social pressures in this agreement are unknown.

Military factor (industrial defense, international prestigious, military capability, and independence and non-vulnerability)

Because this is a civilian case of offset, the military factor is not applicable.

OFFSET OUTCOME

The expected outcome of a typical countertrade agreement is sometimes very nebulous. The benefits obtained through an agreement like the MD-11 are only partially available due to the numerous variables that are difficult to identify.

For example, if the government decides to impose this offset policy and it becomes evident that the price of the aircraft is increasing because of the offset clause, who will pay the difference between the price with offset and the price without offset? The following outcomes of the MD-11 raise some interesting points that will be used as the basis for further recommendations to the Brazilian government in Chapter Six. The MD-11 case results is shown on Table 8.

Q18) Does this agreement provide independent technological capabilities?

The MD-11 case reveals some interesting results which occur in the countertrade type of offset. Although the transfer environment and the suppliers characteristics are favorable in most of these offset transactions, the integration of technology does not reach the same level as it would in another type of offset. This may prove that offsets in this particular area (countertrade) sometimes are not required by the buyer but are used mainly by the sellers as a tool to marketing competitively. Another observation is that the technology transferred through countertrade arrangements is not considered "leading" technology. The explanation for this is that some transactions are not really a good deal for sellers because of fierce competition and the fact that negotiations tend to reduce the profit margin. Large aircraft manufacturers are not always willing to transfer "high-tech" to recipient countries because the contract does not cover the administrative costs involved in this transfer. Another observation collected in interviews and evidenced in this particular case is that developing-country industries must have a technical capacity installed previous to the contract because legislation requiring offsets

should be supported by the capacity to offer the service or production competitively. For example, it would be very difficult for the Brazilian government to require MCD to transfer part of the production if the Brazilian companies would not already have the technical capability to produce wing flaps with composite materials.

In summary, this case demonstrates that EMBRAER was perfectly capable technically to accomplish the contract. But the technology transferred to EMBRAER did not add to its technological capability. Therefore, the technological capability outcome rests between these two extremes, and the value is medium. The resume of this outcome is on Table 5.

Table 5

CASE: MD-11	
VARIABLES	GRADE
Q17) OFFSET TYPE	COUNTERTRADE
Q1) TYPE OF TECHNOLOGY	LOW
Q2) TRANSFER ENVIRONMENT	HIGH
Q3) RECIPIENT'S CHARACTERISTICS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM

OUTCOME

Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM

Q19) Does this offset improve Brazilian national security?

It is not expected that countertrade arrangements result in large benefits for the national security outcome as was defined in this thesis. Although countertrade has been supported politically in other countries, the same does not happen in Brazil. The reasons why these arrangements are not made frequently ranges from total lack of knowledge of their benefits to difficulty in getting political support from the various government sectors. The initiative of the Aeronautics Ministry in establishing a sectoral offset policy has been supported only partially by the airlines companies, since many barriers still existe in private sector. The socio-political factor is very important in the implementation of an offset policy if it is to achieve successfully the estimated benefits. Although spinoffs to the military may flow from this agreement, this factor was not analyzes. Summing up, because of the lack of commitment from other government sectors in supporting the offset policy, and the lack of firm evidence regarding possible spinoffs, this outcome is rated medium. The partial grades are shown on Table 6.

Table 6

CASE: MD-11	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVATION	MEDIUM
Q11) GOVERNMENT ACTION	MEDIUM
Q12) POLITICAL AND SOCIAL PRESSURES	UNKNOWN
Q13) INDUSTRIAL DEFENSE	N / A
Q14) INTERNATIONAL PRESTIGE	N / A
Q15) MILITARY CAPABILITY	N / A
Q16) INDEPENDENCE/NON-VULNERABILITY	N / A
OUTCOME	
Q19) ENHANCEMENT NATIONAL SECURITY	MEDIUM

Q20) Does this offset improve Brazilian economic capability?

The economic benefits of countertrade agreements are always questioned by economists. It is obvious that the MD-11 agreement has benefited the Brazilian economic capability by supporting jobs, promoting exports of Brazilian-made products, improving the production efficiency, etc. But if this countertrade would not have happened, would these things happen anyway? The EMBRAER contract was signed before the legislation was enacted and VARIG had already specified the MCD aircraft before any agreement had been negotiated. The offset arrangement, as considered by the Aeronautics Ministry, would not improve the financial capability of the Brazilian companies involved. The probability of saving hard currency is remote because of the foreign exchange difference, which would

have benefited the Central Bank but at the same time hurt EMBRAER's foreign exchange account. Due to this pessimistic evaluation of the results, incremented by Brazil's critical economic situation at the time of this agreement, the economic capability outcome is expected to be low. The general grades under this outcome is shown on Table 7.

Table 7

CASE: MD-11	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	LOW
Q8) EXPORT EXPANSION	MEDIUM
Q9) ENHANCE FINANCIAL VIABILITY	LOW
OUTCOME	
Q20) ECONOMIC BENEFITS	LOW

Table 8

CASE: MD-11	
VARIABLES	GRADE
Q17) OFFSET TYPE	COUNTERTRADE
Q1) TYPE OF TECHNOLOGY	LOW
Q2) TRANSFER ENVIRONMENT	HIGH
Q3) RECIPIENT'S CHARACTERISTICS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	LOW
Q8) EXPORT EXPANSION	MEDIUM
Q9) ENHANCE FINANCIAL VIABILITY	LOW
Q10) INT/EXT POLITICAL MOTIVATION	MEDIUM
Q11) GOVERNMENT ACTION	MEDIUM
Q12) POLITICAL AND SOCIAL PRESSURES	UNKNOWN
Q13) INDUSTRIAL DEFENSE	N / A
Q14) INTERNATIONAL PRESTIGE	N / A
Q15) MILITARY CAPABILITY	N / A
Q16) INDEPENDENCE/NON-VULNERABILITY	N / A

OUTCOME VARIABLES	GRADE
Q18) TECHNOLOGICAL INDEPENDENT CAPABILITY	MEDIUM
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH
Q20) ECONOMIC BENEFITS	MEDIUM

B. TECHNOLOGY TRANSFER

This section analyzes an example of a technology transfer type of offset. The trade of advanced military technology through offset arrangements is one of the most complex transactions, because it attempts to balance the needs of a recipient country with the requirements of the supplier country national security. The threat arises from the recipient country abilities to exploit the technological capabilities of a system through reverse engineering and then promote other transfers to non-allied nations. Specifically the U.S. government stringently controls transfers of advanced weapons systems abroad, placing extensive restrictions on the buyer ("end-user" clause). The BRASILSAT case powerfully shows how offset and technology are related and how the other socio-political, economical, and military factors reacted.

1. The BRASILSAT Program Case

The BRASILSAT case is related to the Brazilian government acquisition of two communication satellites and their respective launcher services to replace two existing ones that were orbited in 1985 and 1986. The case is a typical case of an offset arrangement in which technology transfer is the key characteristic. This case is currently being negotiated, so the answers to each of the questions (i.e., the values generated for each of the variables) represent forecasts by the author.

Q17) What are the offset agreement characteristics?

The main contracts and respective offset agreements are currently being negotiated[187]. The subjects of the major contracts are the acquisition of two communication satellites and two respective launcher packages, both to be delivered in 1995 and 1996. The second generation satellites (BRASILSAT B1 and B2) will be orbited in substitution of existing orbited satellites BRASILSATs A1 and A2 (the first generation agreement), after their active life is extinguished[188].

The companies involved in the **satellite bid** are Spar Aerospace Ltd. from Canada[189], Hughes and General Electric from the United States, Matra from France, and Dornier from West Germany. The others involved in the **launcher service bid** are McDonnell Douglas (MCD with the DELTA II or THOR rockets), and Ford Aerospace (TITAN rocket) from the U.S., Arianespace (ARIANE rocket) from France, and the Chinese Great Wall Industry Corporation (Long March

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[187]The Brazilian government opened an international bid in February 1989. Some McDonnell Douglas officials believe that the main reason for the Brazilian government delaying the negotiations is the presidential elections in Brazil in November 1989 [Ref. 1].

[188]The author is assuming that this second generation satellite agreement will be divided into two parts, one related to the satellites and the other related to the launcher service. In the first generation agreement, Spar was the major contractor and it was responsible for the Ariane subcontract to launch the satellites. This division does not mean that they are completely independent at this time. In fact, they continue to be intrinsically connected.

[189]This is the same company that built Brazil's first generation of domestic communication satellites under license from Hughes Aircraft Co. in 1985.

rocket). These three groups of bidders will be analyzed as the U.S. group, the French group, and the Chinese group[190].

In the **satellite bid**, two state-owned Brazilian Telecommunication companies are responsible for managing the satellite bid: EMBRATEL (Empresa Brasileira de Telecomunicações) and TELEBRAS (Telecomunicações Brasileiras)[191]. Both companies share the responsibility to operating the Sistema Brasileiro de Comunicações Via Satélite (SBTS) and have experience in negotiating international bids. The National Institute of Space Research (INPE) is responsible for developing the Brazilian Satellites and gives some technical support to the choice and localization of satellites.

The firms that presented proposals also included offsets. In the U.S. group, Hughes offset proposal includes a countertrade of auto parts[192]. In the French consortium, the Canadian Spar offset proposal includes the acquisition of EMBRAER Tucanos for the Canadian Air Force and space segment components

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[190]Negotiating with these three different groups is complicated by the technical incompatibility between satellites and launcher vehicles. According to McDonnell Douglas officials interviewed, the Delta rocket cannot launch Spar satellites because of weight and other incompatibilities. It was not determined if the same occurs with the Hughes satellites to be launched with the Ariane rocket. The Chinese compatibility is unknown [Ref. 1].

[191]EMBRATEL is the SBTS owner and operator. TELEBRAS is responsible for domestic long distance links and all international services [Ref. 2].

[192]In 1985, General Motors (GM) acquired Hughes Aircraft Company. Becoming part of GM broadens considerably the potential offsets that Hughes did not have to offer in BRASILSAT's first generation agreement. GM plans to handle the offset side of the contract in auto parts. GM in Detroit already imports from its Brazilian subsidiary some $120 million in 1988 and also imports from other Brazilian companies [Ref. 3].

in composite materials also from the same Tucano's manufacturer [Ref. 3][193]. An interesting point is that both proposals did not include either technical assistance or technology transfer, including only countertrade and subcontract of 100% of the contract value offered[194].

In the **launcher service bid**, the Brazilian Aeronautics Ministry, responsible for conducting the military side of the space program and for following an "intrinsic offset policy"[195], asked for the transfer of missile technology in offset for the launcher service contract[196]. McDonnnell Douglas and Arianespace had already presented their proposals, creating a controversy related to the transfer of sensible missile technology to third world countries [Ref. 5]. The Chinese proposal has not been publicized up to now[197]. The McDonnell Douglas proposal includes the offer

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[193]This consortium includes the France's Matra. This alliance was done probably to reach technically the Hughes new version satellite.

[194]It was not possible to access the solicitation for the satellites bid that would include any clause requiring offset. As said before, there is no legislative requirement to report offsets. The first agreement had some kind of technical assistance to train EMBRATEL personnel to operate the satellite communication, but no technology transfer was mentioned.

[195]The author means by this term an offset policy that the Aeronautics Ministry has concentrated on, although there is no evidence of the existence of a written document or regulation specifically about satellites and launcher service negotiation.

[196]It was not possible to ascertain the type of technology that MAER asked in offset for the launcher service. It is supposed that Brazil had asked for liquid-fuel and guidance systems technologies, both under Category I of the MTCR. With these technologies the recipient country may be capable of launching rockets with a range of 300 km with a "circle of error probable" (CEP) of 10 km [Ref. 4].

[197]According to Marcio Nogueira Barbosa, head of INPE, the agreement is still being negotiated with China [Ref. 3].

to let Brazilian aerospace engineers perform 60 worker-years of labor on projects such as the proposed U.S. orbiting space station, two scholarships for Masters or Doctoral degrees at Purdue University, and an option for marketing services inside the U.S. for Brazilian products[198]. The Arianespace offset proposal includes the transfer of Viking rocket technology. Both proposals seem to reach 100% of the original contract value[199]. The U.S. price proposed was about $110 million for the two launches. The French amount is unknown but considering that Brazil paid $130 million to Spar (total contract including satellites and launcher services) and Ariane offered $58 million just for the first two launches[200], it seems that the difference favoring France is not significant[201]. Therefore, for the launcher service, both offset proposals include transfer of technology, although MCD proposed what is considered "know-how".

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[198]The information about the last two offers comes from a personal interview at McDonnell Douglas. The last offer is optional and it is conditioned on a payment of $5 million for the service [Ref. 1].

[199]The values were relatively easy to ascertain since the main concern in this international bid is not the price but the offset that rests inside the contract.

[200]The exact value of the first generation satellites was very dubious because of the variety of numbers reported in different sources. Two sources presented the total estimated value of the first generation BRASILSATs, including the launcher services, was about $250 million [Ref. 6 and 7]. Two other sources show that the total cost of Spar contract was $131 million [Ref. 8 and 9]. A third source reduced this last value to $122.5 million. Finally, last source shows that Ariane offered to Spar $58 million for the two launchers ($29 million each) [Ref.10 : p.442]. This last source seems to be the most reliable.

[201]In early 1988, Aerospatiale was charging $45 million to place a 1,100 kg satellite in geostationary orbit, which should be add $25 million for a total insurance mission [Ref. 10:p. 422].

It seems that the time for implementation of both offset proposal sets will be extended for at least 6 years (until 1996), the minimum lead-time for the last launcher of the second satellite.

The method of enforcement that probably is going to be used for the Brazilian government would not change, staying in the "best effort" category for both satellites and launcher service offset proposals.

The financial arrangements included in these proposals were only partially ascertained due to the uncertainty that surrounded the agreement. The U.S. proposal for the satellites and respective launcher services probably would have some financing by the Eximbank[202]. To finance this project, Hughes promised 100% fixed rate credits from the U.S. Eximbank. The MCD financial arrangements would be similar. The French proposal also includes 100% financing provided primarily by Canada's Export Development Corp (EDC) and Compagnie Francaise d'Assurance pour le Commerce Exterieur (COFACE). The financial arrangements will be one of the most important variables in defining the future of this contract due to Brazil's external debt and the uncertain policy of the next Brazilian government related to foreign debt[203][Ref. 3].

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[202]In the first contract it was reported that Eximbank provided $27.6 million toward financing the part of the project related to Hughes, that indirectly produced 27.5% of the BRASILSATs [Ref. 8 and 11].

[203]In the first agreement, EMBRATEL had part of the funds released through Brazil's Central Bank, and a significant part was conditioned on an external loan from Canadian Banks. The Royal Bank of Canada and the Bank of Nova Sotia approved a $110 million loan to Brazil for the system on behalf of a consortium consisting of eight Canadian banks [Ref. 8].

The "end-user" clause would be a critical factor if the U.S. releases the rocket technology package as part of the arrangements for offset launcher service. The U.S. is convinced that if they released this technology to Brazil, there would be a great risk that this country would develop ballistic missiles for nuclear purposes. The possibility of a "end-user" clause also is great in the French launcher package, not because of their concern for releasing technology but due to the international pressure from the signatories of the Missile Technology Control Regime (MTCR) agreement.

Q1) What type of technology will be transferred?

The technology embodied in these offset proposals is a very interesting example of the difference between technology and know-how[204]. The MCD is offering what they called "know-how". This proposal seems to be far from what the Brazilian government had asked, because of the U.S. government constraints in releasing this kind of technology to Brazil. It seems that, within the U.S. government restrictions, this offset package is the best deal that could be offered to Brazil. The French Ariane is offering a technology package that includes the license to produce parts of the Viking liquid rocket engine used in Ariane[205][Ref. 5].

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[204]The discussion about the technology factor was limited to the offset proposals related to the launcher service, since the satellite proposals only contain counterpurchase negotiations.

[205]For obvious reasons it was not possible to ascertain the product designs and production techniques included in the French proposal.

According to some specialists this French technology is at least 25 years old[206]. Although both offset proposals are excellent offers, the author forecasts that if the Brazilian government officials only consider the short-term technological benefits, they will prefer the French proposal, even with the old technology. Considering this estimate, the type of technology variable may be graded as medium.

Q2) What is the technology transfer environment?

The technology transfer environment for this agreement is somewhat complex due to the numerous variables involved. The competition among the three main groups: the U.S. group, the French (technically connected with the Canadian consortium) group, and the Chinese group is fierce. The U.S group is highly motivated to win this Brazilian contract, but the restrictions posed by the U.S. government will constrain the U.S. industries' abilities to negotiate better terms with the Brazilian government. Once more the U.S. industries may lose deals to other competitors because of the political constraints connected to the transfer of technology. The French group is also motivated to continue the supply of the second generation of BRASILSATs. France is offering rocket technology under license probably in exchange for cheap labor, abundant steel supply, proven industrial capability, and mainly to sustain the Latin America market position [Ref. 12]. Another motivation, similar to the German restrictions in exporting arms outside NATO countries, may be that the French will try to use indirectly the label "made in Brazil" to overcome some of the political restrictions on its arms exports.

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[206]This information was collected in one interview with McDonnell Douglas on 12 October, 1989 [Ref. 1].

The Canadian Spar is also interested in maintaining its own customer in South America. There is no evidence that Spar is seeking to transfer satellite technology to Brazil through license or coproduction arrangements, but it would be anxious to subcontract EMBRAER to supply the honeycomb panels in composite material not only for the new BRASILSATs but for other future Spar sales. Finally, the Chinese group wants to expand its market to Latin America. Although they have a relatively low level of technology in relation to the other bidders, the transfer environment seems to be very difficult because of language, drawings, etc. The PRC and Brazil agreement to coproduce an earth imaging satellite to be launched in 1992 may be an important indicator that Brazil may favor China when negotiating agreements for technology transfers associated with satellites dissociated from the rocket[207].

Brazilian development and production of satellites and launcher vehicles seems to be constrained basically because of lack of government funds for research[208]. With insufficient funds, the Brazilian agencies have conducted only limited research with numerous problems such as the transfers of high level personnel to private industries. Another critical constraint is posed on the product itself, where researchers have opted for the inexpensive but demanding process

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[207]This dissociation maybe is a result of the dissociation between INPE satellite and IAE rocket initiatives.

[208]According to Raupp, in 1989, the INPE asked for $600 million and received just $170 million [Ref. 13].

of substituting technology for labor-intensive processes to make the technology viable[209].

The potential size of the market that would be developed with the technology acquired through this offset agreement seems to be restricted at least in the short term. To make the product viable commercially, Brazil will need to export home-made satellites and to provide launcher services with a competitive price in relation to other countries. As of today, this will be difficult to achieve.

The Brazilian government's protection and exchange controls will not be discussed because the nature of the product development (satellite or rocket) has been already strictly controlled by the government.

In summary, the technology transfer environment is evaluated as lying somewhere between very positive and negative. The potential for meaningful technology transfer is enhanced by the incentive of three groups and the ability of Brazil to absorb mid-level technology. These prospects are dampened by the MTCR and other national political constraint, as well as the limited size of the market for space products. An overall value of medium is assigned to this variable.

Q3) What are the recipient firm's characteristics?

The main recipient for the rocket technology transfer will be the Brazilian government through the Institute of Space Research (IAE). After the development

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[209]According to Engineer Jayme Boscov, the chief of the project division of the VLS program at IAE, the option to use four engines instead of one in the VLS is due to lack of facilities in the industrial complex to produce turbines over 1 meter in diameter. Another example is the use of solid-fuel instead of liquid-fuel, which is more effective but also more expensive [Ref. 14].

of the VLS, this project would be transferred to two companies: ORBITA, a new company that will be responsible for coordinating the entire VLS production, and AVIBRAS, responsible for producing the Sonda series rockets.

The IAE, one of the institutes of the CTA, has been working since 1965 in the development of the Sonda series sounding rockets. IAE has demonstrated a continuous evolution of its rockets, even when constrained by technology transfer. The technical absorptive capacity of rocket technology seems to be relatively good. The potential to absorb this technology and to make it commercially viable seems to be one of the first objectives after the complete development of the VLS program. As happened with the Sonda series, IAE would also transfer the VLS to the companies in charge for the series production. This variable is also estimated as medium.

Q4) What are the suppliers firm's characteristics?

The prospective suppliers for this agreement are very interested in being the main contractor, some with commercial incentives and others with political incentives. The prospective suppliers are also divided in three groups. They will be analyzed as supplying the overall system, consisting of satellites and their respective launch services. As said before, some companies are, intentionally or not, interconnected technically. For example, the DELTA II rocket cannot launch Spar satellites because of technical incompatibilities. Besides this technical connection, the European companies also have formed consortia to improve their technical and financial leverage in competitions. The characteristics of each company are detailed on Appendix B, to this chapter, BRASILSAT Bidders Profile.

The first bidding group consists of Hughes and McDonnell Douglas. Both are situated in the U.S. and they are supported by forces in the U.S. government that are interested in winning this contract in Brazil. They say this is a "great chance" to have Brazil become a signatory of the nuclear non-proliferation agreement[210]. MDC will offer the launch service of its new rocket, DELTA II. The company has an excellent tradition in launcher services for more than 25 years. Its participation in the recent NASA Space Station program as one of the major contractors demonstrates its technological capability. The aviation part of the company has been contracting with EMBRAER for the development of composite materials products, and the relationship between supplier and recipient has been very good. Hughes is a traditional company in manufacturing earth satellites for communication. The company has demonstrated some success in the transfer of technology to other countries, exemplified by the success of the Canadian Spar, which produced the first generation of BRASILSATs in 1985 under Hughes license, and today is competing together with Hughes for an international bid.

The second bidding group consists of Spar from Canada and Arianespace from France. Because they offered the best technology package, both were selected on the last Brazilian acquisition and they look like the most probable winners. Spar is a relatively new firm but it is leading a Canadian group

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[210]During one interview with McDonnell Douglas, it was emphasized that the export license from the Office of Munition of the Department of State took only 4 weeks to be approved, when the normal time is around 13 weeks [Ref. 1].

of companies that will work jointly in the NASA Space Station[211]. The previous relationship between Spar and Brazilian companies was not discovered, but it is assumed to be good because of Spar's interest in expanding the Latin American market. Ariane has gained a lot of experience with the Ariane series. It has already launched 38 rockets from its two launcher bases in Korou, Guiana. The advantages accruing to Ariane in this competition are the offset package, the price, and the launcher base location[212].

The third group is China. The Great Wall Industry has developed a continuous sales campaign and has won at least eight foreign orders to launch commercial satellites since 1987. Most of the success of the Chinese launch services has been attributed to their willingness to admit customer's spacecraft previous inspection, and the owners themselves may convey their satellites to the launch site. Another key aspect of China's continuing space expansion is based on acceptance that it must be a two-way street business. This last feature is observed through the constant Chinese interest in cooperation and technological exchanges with the rest of the world sometimes involving the construction of launch sites abroad[213]. From April 1970 (Long March 1) to September 1987, China

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[211]Canada was the first country that entered into the Space Station program because of its technological level.

[212]The location of the launcher base was an important factor considered by the Brazilian government in the first generation agreement. Being closer than the U.S. launcher base (Cape Canaveral), the Ariane rocket saved some fuel and this will add about one year to the life time of the satellites [Ref. 15 and 10:p. 3].

[213]It is reported that China proposed the construction of an $800 million equatorial launch site in Indonesia [Ref. 10:p. 17].

had launched 21 rockets, and it has a world record 100% success rate in payload disposition. Despite this success, the Chinese have some financial problems and are economically restricted to only two launches a year[Ref. 10:p. 18].

Because the French group is forecast as the winner of this competition due to its technology package and previous successful experience in launcher services and satellites, this variable is graded also as medium instead of high if the U.S. would release its rocket technology.

Q5) Will this technology be integrated?

The technology integration variable is one of the most important from the perspective of the Brazilian government. The first critical point is time. Because of the serious political consequences of this delay, the increasing gap between the development of the VLS by the Aeronautics Ministry (MAER) and the construction of the satellites by INPE seems to be the MAER main concern at this time. In this case, the French proposal, which only partially achieves the technology transfer objective, seems to be the best short-term option. The second point is personnel skills. The main concern of the MAER is to maintain its cadre of scientists technically and financially satisfied with the VLS development program. Because of the economic situation, scientists and engineers are transferred to private companies, looking for better salaries, even to work in a completely different environment from research. The third point about the proportion of the service sector in relation to specialized sector was not assessed numerically, but this proportion may be estimated from the INPE institute that has in its cadre 5% with doctor's degrees, 10% with master's degrees, and 28% with bachelor's degrees.

Theses percentages, although from the other center, may be used to give an idea of the high level of researchers in IAE.

Considering time, skills, and the proportion of service sector in the VLS program, the technology integration capacity is rated as high.

Q6) Does this offset agreement conserve foreign exchange?

In October 1987, the Minister of Aeronautics Otavio Moreira Lima stated that the launch of SONDA IV rocket was of vital importance for the development of rockets like the Ariane, and with the improvement of current technology development, Brazil would be able to launch its own satellite at a much lower cost and would save hard currency in the future [Ref. 16]. The benefits in savings of hard currency in this agreement assume various dimensions. First, with the development of the VLS, Brazil wouldn't need to expend foreign currency for future launcher services. The same would occur with the satellites. Another saving obtained since the BRASILSATs A1 and A2 has been that Brazilian companies do not need to pay for leasing other satellites from other countries (e.g., International Telecommunications Satellite Consortium - INTELSAT).

The conservation of foreign currency through future savings has been one important motivation in this agreement, although it does not seem to occur enough in the short term to improve the economic capability outcome. The grade for this variable is medium.

Q7) Does this agreement create jobs?

It seems that the main motivation of this proposed offset agreement related to the creation of jobs is to support the employment of the high level

scientists, engineers and technicians not only in IAE but also in INPE. Another aspect of the offset proposal relates to the employees from GM of Brazil and EMBRAER whose numbers will increase due to the sales increasing in autoparts and Tucanos, and composite materials respectively. Internationally, this contract seems to be very small to cause such employment impact, but considering that these two companies are working close to full capacity and the relatively cheap labor cost in Brazil, one offset of $110 million is relatively a medium impact.

Q8) Does this offset improve exports?

On the satellite side it is obvious that if Brazilian companies will obtain the technology through offset, this will contribute to export expansion in basically two ways. First, Brazil may sell satellites and launcher services to other countries. Some governments such as Iraq have already received proposals from the Brazilian government for the acquisition of a military observation satellite made in Brazil. This satellite is expected to have the same basic requirements established by INPE for the first Brazilian satellite for remote sensing from an orbit of an altitude of 700 km and weighing about 150 kg. The Brazilian proposal also includes the possibility of Iraq procuring a lab for manufacturing and testing satellites similar to the INPE facility in São José dos Campos. The Brazilian made satellite costs $40 million and has at least France as the other competitor in this bid. Second, Brazil may lease some channels and television programs and this may be considered as service export. The leasing of spare capacity with other countries is a profitable

business[214]. The television business is of somewhat more economic interest for Brazil. Brazilian television has reached the international pattern, and "mini-series" and soap operas are being exported to Portugal and various Spanish speaking countries.

Because of the long-term return on the investment and the Brazilian inexperience in marketing future products due to the projects being strictly restricted to the government without private companies participation, this variable would be considered as low impact.

Q9) Does this agreement enhance the financial viability of the project?

The actual financial situation of Brazil is critical. The situation of maintaining the highest external debt in the world leaves Brazil very vulnerable and with low leverage in financing these kinds of space projects. Officials in developed countries always feel right in asking: Why BRASILSATs and rocket technology if the Brazilian people need urgent social programs? Despite this situation, Brazil has continued to obtain financing from foreign commercial banks and other financial entities such as IMF, Paris club, etc. The offset in this case will be used as a resource to continue buying critical equipment without increasing the level of indebtedness. The conditions offered by the bidders seem appropriate for obtaining interim financing between the time of acquiring satellites and launcher services, and

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[214]EMBRATEL offered to lease channels for between $1 and $1.6 million or to sell them at $4.8 million each to seven neighboring Latin American countries -- Colombia, Peru, Venezuela, Ecuador, Paraguay and Bolivia [Ref. 10:p. 3]. Colombia, Argentina and Venezuela are actually leasing more than 1% of Intelsat's services [Ref. 10:p. 352].

the time when credit is obtained for the deliveries of Tucanos, auto parts, or composite materials.

Considering the financing offers, the lead-time to deliver the counter-purchase, the French technology licensing, and the medium amount of foreign currency involved, a value of medium is assigned to the impact this offset will have on the overall economic situation.

Q10) What are the internal and external political motivations for this agreement?

Due to the peculiarity of mixing military and civilian objectives and ministries and the actual situation of radical change in politics in Brazil, this agreement is expected to experience political pressures from a variety of groups. The military certainly will continue to exert much influence in the decision-making process. There are two major military objectives in this agreement. First, the missile technology would provide a new way to continue the development of the SONDA IV program that seems on hold not only because of a lack of resources but mainly because of technical problems that are difficult to solve in a short time. Second, the increasing international interest in the Amazon forest is causing a lot of concern with respect to the protection of the immense jungle territory. In this case, communication satellites certainly will help the task of remote sensing satellites in controlling the air space, monitoring forest fires, and localization of border invasions. Industries also have an interest in this agreement. EMBRAER, for example, may expand the market for its Tucanos to the Canadian Air Force, considered an important step in the marketing of this trainer aircraft. Other political

motivations will be expressed through the two new civilian Ministries (Communication and Science and Technology) because of the importance of continuing to supply the Brazilian customers with better services and technology sufficient to develop indigenous satellites. Congress will be motivated to participate in this agreement because of its new power over the Brazilian government budget.

Considering the radical changes expected in the political environment in Brazil in 1990, the relative distribution of the decision power related to both a military and civilian product, it is easy to assign a value of high to the socio-political impact of this case.

Q11) How does the government act in this offset?

The Brazilian government is developing an active role in this agreement. The negotiations certainly will be divided into two parts: the satellite part involving the contract department of EMBRATEL and TELEBRAS, and the launcher service contract, involving the contract sector of the MAER. Both negotiations will to be coordinated by the COBAE. The idea of requiring offsets in each sector of negotiations seems to be prevalent and strategically used by both sets of government agencies. The other kinds of government action in the future may be in financing supply or offering facilities such as Barreira do Inferno to track the launches from Korou.

Considering the complete involvement of Brazilian government in this agreement because of the great amount of governmental interests, it is also easy to grade this government action variable as high in terms of contributing to the outcome.

Q12) What are the political and social pressures of this agreement?

It is expected that there will be significant political and social pressure for this agreement. The new Brazilian Constitution enacted in October 1988 asked for some complementary law to differentiate between the civilian and military parts of the Brazilian Space Program. In 1990, with the new President, it is estimated that Congress would have stronger influence in the definition of the new policies concerning the restructuring of COBAE. It is also forecasted that the military would continue with the VLS program and with the administration of Alcantara and Barreira do Inferno launcher bases, but it would become less powerful to influence decisions related to satellites and earth stations. This part would be shifted completely to the companies under the responsibility of the Communications Ministry. The technocrats will pressure the new government because of the impact of this agreement on the foreign debt. Probably, to be approved, it will require a detailed lease-buy analysis to justify this new second generation of satellites besides a complete review of the first BRASILSATs cost/benefit analysis. EMBRATEL and TELEBRAS would have an important role in concluding this agreement. They would have power to impose a technically and economically feasible solution, instead of a political one. Important pressures would come from EMBRAER in favor of the Canadian proposal because of the possibility to offset Tucanos and composite materials and also by GM of Brazil and other Detroit suppliers towards the U.S. proposal. The labor unions are expected to improve their leverage in these kind of agreements and they even may conflict with

themselves[215]. For example, the Sao Bernardo do Campo labor union would be favorable to the GM (Hughes) proposal and the EMBRAER union would prefer the Spar proposal, which would provide more jobs. Finally, the population also would exert tremendous pressure if the press started announcing, for example, that the Brazilian people would not watch their favorite soccer team live if the satellite facility would not be possible anymore, in case of problems in replacing the first generation BRASILSATs.

The increasing socio-political democratization of the country certainly will bring agreements to a more detailed discussion in various sectors, either inside the government or other civilian sectors. It would be estimated that the socio-political pressures will be high in influencing this agreement, particularly as it relates to the overall national security.

Q13) What are the benefits of this agreement for national industries producing military equipment?

The improvement of the space industry is always a major challenge for any country. The spinoff benefits that this technology brings to the technical improvement of the weapons systems is substantial. The agreement includes the technology necessary for Brazilian launcher rocket development. According to some specialists, the spinoffs of this technology for the development of ballistic missiles for military purposes are a fact that not only involves Brazil but also most

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[215]In the beginning of 1988, The EMBRATEL labor union cancelled contracts because they were a breach of the constitutional principal of state monopoly in telecommunication. This incident cost the entire board of EMBRATEL their jobs[Ref. 17].

of the developing countries that produce arms. The missile is an inexpensive and effective weapon. Due to a series of developed countries boycotts, the third world turned to develop its own indigenous missiles, based mainly on technology transfer or heavy domestic R & D. The question of Brazil redirecting its space program to specifically develop medium and long-range missiles is somewhat complex and beyond the scope of this thesis. But taking for granted that Brazil is using this process to improve its missile production, this process has been slowed down by the technological gap and barriers imposed by developed countries. Therefore, this variable grade was medium due to the significant gap between the success in developing commercially and technically feasible ballistic missiles for military purposes.

Q14) Does this agreement bring international prestige?

The acquisition of two more satellites and even the substitution for the other two that are still in orbit will bring high international prestige to Brazil. The BRASILSAT's make Brazil a member of a select group of countries that have the same level of independence. It is the only country in South America that has its own satellite system. EMBRATEL has been offering to lease channels or sell them to seven neighboring Latin American countries - Colombia, Peru, Venezuela, Ecuador, Paraguay, Uruguay and Bolivia [Ref.10 : p.3]. This kind of commercial cooperation certainly will give Brazil a leading position in the continent. Some of the Latin American countries are not satisfied with INTELSAT's intergovernmental

agreement that is based on the same price for all users of its services, regardless of the number of circuits a country requires[216].

Q15) How does the technology embodied in this offset improve the national military capability?

The utilization of communication and remote sensing satellites has been one important feature that improves the air-space control and military communications in distant locations. Brazil has been dealing with a lot of communication problems towards the south and north regions. The dense Amazon forest has been one of the most difficult locations to access. The previous INTELSAT services were not dealing with this kind of demand because of their location. This is one of the reasons why Brazil chose to have their own satellites, in specific orbit locations to better access this region. Today, in terms of satellite communications, the Brazilian military is sharing the same facilities as the civilian systems, but in the future probably the services will have their own systems. In terms of rocketry, Brazil has continually developed and produced rocket systems which are very inexpensive and simple, but very effective at a short distance[217]. The expansion of the range, the payload capacity, and the precision are now the main objectives.

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[216]In the case of Colombia and Peru, they are arguing that INTELSAT cannot provide the circuits they need for Spanish-language live feeds at prime time [Ref. 10:p. 352].

[217]There is an interesting trade-off between range and payload in ballistic missile systems. If you reduce the payload, the range improves and vice-versa.

Objectively, the military capability variable may be improved with time. Today, it seems that the technology embodied in this offset proposal will give a medium contribution to Brazil's military capability.

Q16) How does this agreement contribute to the country's independence and non-vulnerability?

This last variable may be analyzed with one example of dependence and vulnerability that a country has if it continues to have satellites under leasing with a developed country. In 1982, during the Malvinas war the United States turned off the GOES satellite, and Argentina had no other source for remote sensing [Ref. 13]. The same may happen to any other developing country with the same vulnerability. Therefore, it is easy to see that this agreement, although not satisfactory in all aspects, would bring, at least, partial independence because the communication satellites are an important part of the entire range of resources that may be available from space[218]. This variable was graded as medium importance in determining the outcome of this case.

OFFSET OUTCOME

The outcome variables of this case show interesting findings as a result of a supposed offset package obtained in compensation by the acquisition of satellites and launcher services. Because is difficult to label this case as a "civilian case" due to the numerous applications of satellite and rocket technology for military purposes, all four factors were analyzed. The results from these

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[218]Brazil is still using INTELSAT (a small portion) and Landsat for remote sensing. The central station of remote sensing is located in INPE [Ref. 18 and 10:p. 3].

independent variables were grouped in three main outcomes as was explained in Chapter One and are shown on Table 12.

Q18) Does this agreement provide independent technological capabilities?

The rocket technology that Brazil needs to continue developing its VLS program is considered fundamental for the process of negotiating offset agreements in the satellites acquisition and launch services. Despite the fact that the Brazilian government has been making great efforts to obtain technology sufficient to reduce the delays and technological bottlenecks of the VLS program, this action has been boycotted by developed countries. The final outcome would be a serious constraint for the technology barrier. All of the five independent variables related to this outcome predict that this future agreement will have a medium impact on the independent technological capability. The results are shown on Table 9.

Table 9

CASE: BRASILSAT	
VARIABLES	GRADE
Q17) OFFSET TYPE	TECHNOLOGY TRANSFER
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	HIGH

OUTCOME	
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM

Q19) Does this offset improve Brazilian national security?

The socio-political and military factors discussed indicate that this agreement will be tremendously affected by the political environment in Brazil today. This fact may change previous behavior and traditions, such as the predominant position of the military over the space program, the passive role of Congress, and also the new direction of state-owned enterprises such as EMBRATEL and TELEBRAS towards privatization. All of these changes will lead to a high national security capability outcome representing all of the substantive changes in the Brazilian government objectives in the 1990s, shifting from "military application" of the technology in the arms production to a wider "civilian application" of the same technology to socially improve the living conditions of the Brazilian people. The grades under this offset outcome is found on Table 10.

Table 10

CASE: BRASILSAT	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVES	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	MEDIUM
Q14) INTERNATIONAL PRESTIGE	HIGH
Q15) MILITARY CAPABILITY	MEDIUM
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM
OUTCOME	
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH

Q20) Does this offset improve Brazilian economy capability?

The economic benefits of this agreement are a consequence of the previous technology and national security benefits. This means if the Brazilian government is to solve its dramatic economic problems, they need the technology and the socio-political resurgence first. In a small scale of this agreement, it is draw every risks that the Brazilian government may be exposed if it won't be able to continue weighing these three outcomes in every international negotiation. The variable results from this outcome show that perhaps a large gap will still exist in the commercialization of the rocket technology obtained through this offset agreement. This result also may direct the Brazilian officials to a more detailed study about the short and long term benefits of this technology, which will certainly

help in establishing adequate strategies. The outcome of this agreement is graded as a medium contribution to improve the economic capability. This outcome grade is explained on Table 11.

Table 11

CASE: BRASILSAT	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	MEDIUM
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	MEDIUM
OUTCOME	
Q20) ECONOMIC BENEFITS	MEDIUM

Table 12

CASE: BRASILSAT	
VARIABLES	GRADE
Q17) OFFSET TYPE	TECHNOLOGY TRANSFER
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	HIGH
Q6) FOREIGN EXCHANGE SAVINGS	MEDIUM
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	MEDIUM
Q10) INT/EXT POLITICAL MOTIVATION	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	MEDIUM
Q14) INTERNATIONAL PRESTIGE	HIGH
Q15) MILITARY CAPABILITY	MEDIUM
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM

OUTCOME VARIABLES	GRADE
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH
Q20) ECONOMIC BENEFITS	MEDIUM

C. LICENSED PRODUCTION

This section shows two examples of licensed production offset agreements. Licensing is becoming very instrumental in technology transfer. The term usually contains the basic element of granting a right at a price. A licensing agreement transfers industrial property rights (patents and trademarks) and technical know-how to an unaffiliated licensee in return for compensation (royalties or license fees) paid to the licensor. The two cases of licensed production agreements provide a comparison between a civilian and a military agreements in which the government participation is the crucial difference. Another important factor is the time. For instance, the Piper cooperation program (in 1974) found a more favorable environment than the Aerospatiale project (1988). Finally, the cases define the differences in the government support which is related to the government proprietorship and control over the industry.

1. The Piper General Aviation Case[219]

The Piper general aviation case was selected as an example of a licensed production type of offset agreement[220]. Like in the previous cases, this case will be analyzed within the same framework described in Chapter Two. The Piper case is a relatively old case of the mid-1970s, but it still remains as an active contract. The case is a cooperation agreement formed between EMBRAER and

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[219]This discussion is based on Baranson [Ref. 1 and 2] and various periodical articles.

[220]One point that should be emphasized is that this agreement is an example of a civilian offset, where there is no government-to-government agreement. This characteristic fits with the definition of licensed production made in Chapter Two.

Piper for manufacturing small and medium general aviation Piper models in Brazil under license. It is a very typical case of the commercial offset relationship between companies, where the government acted more as a policy maker than as a direct agent. In addition, this case emphasizes the technology transfer as a strategy to shorten the production time of aircraft with the objective of dominating the market.

Q17) What are the offset agreement characteristics?

In August, 1974 Piper Aircraft Corporation entered into a 10-year industrial cooperation program with EMBRAER, based on two agreements -- one for single engine aircraft and the other for twin-engine aircraft -- which allowed EMBRAER to select any Piper model it wished for local production [Ref. 3:p. 18]. It was the first EMBRAER important joint venture for EMBRAER in the civil aviation field. Under this licensed production agreement EMBRAER has been producing six aircraft models: the Navajo (Navajo Chieftain), the Seneca, the Minuano (Cherokee six), the Corisco (Arrow II), the Sertanejo, and the Carioca (Pathfinder) [Ref. 4:p. 50]. Table 13 shows the Piper models produced by EMBRAER. This program is basically a licensed production agreement, but at the time the agreement was signed it was expected that, in the medium and long term, it could provide for the cooperative development [Ref. 2:p. 31].

Piper has been responsible for providing the necessary assembly and the parts manufacturing know-how, as well as for assisting in some areas such as quality control, materials handling, and manufacturing[221] [Ref. 5:p. 29]. The

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[221] Piper also includes in the agreement an option to use its international distribution system for aircraft that may be exported from Brazil.

TABLE 13

PIPER MODELS PRODUCED BY EMBRAER

MODEL (EMB)	NAME (EMBRAER)	PIPER MODEL	CAPACITY (CREW+PASS)
710	CARIOCA	PA-28-236 DAKOTA	1 + 3
711T	CORISCO	PA-28-RT-201 ARROW	1 + 3
711ST	CORISCO	PA-28-RT-201T TURBO ARROW	1 + 3
712D	TUPI	PA-28-181-ARCHER II	1 + 3
720D	MINUANO	PA-32-301-SARATOGA	1 + 5/6
721D	SERTANEJO	PA-32-301-SARATOGA SP	1 + 5/6
810D	SENECA III	PA-34-220T-SENECA III	1 + 5/6
820C	NAVAJO	PA-34-220T-NAVAJO CHIEFTAIN	1 + 7/9
N-821	CARAJA	SCHAFER COMANCHERO 500 (*)	1 + 7/9

Source: General Information, Brazilian Aeronautical Industry, EMBRAER, São José dos Campos, Brazil.

agreement permits EMBRAER to: (1) fabricate Piper aircraft for sale in a domestic market and, occasionally, to produce jointly with the U.S. company for foreign market sales; (2) replace on a gradual scale Piper-supplied components with EMBRAER-fabricated products; (3) initiate cooperative programs, sharing development and production of a new aircraft with the object of selling in domestic or foreign markets; and (4) market one another's products through individual distribution networks.

The price of the contract was not ascertained because of the numerous phases of the contract containing different kits and consequently different prices. No royalties have been paid for this agreement. The U.S. firm's compensation has been primarily a percentage return on the components shipped to EMBRAER. Although the returns would diminish as the licensee progressively substitutes local

content for these imported outputs, Piper would continue to be paid a fee for support service. Since 1983, Neiva has been assembling imported parts from the U.S. and parts produced in Brazil. At that time, the licensed production program was extended to 1989 [Ref. 3:p. 18].

In July 1986 a new deal was concluded with EMBRAER, which was called Phase 8 of the main agreement[222]. It included the supply of 156 completely knocked-down aircraft kits which had to be delivered in 18 months at a value of $14 million[223]. At that time, the Piper president Frank Manning said that more than 2000 kits had been supplied to EMBRAER under agreements worth $100 million [Ref. 7].

Q1) What type of technology is being transferred?

Throughout these 15 years of the agreement, no sort of design work has been transferred to EMBRAER since the aircraft look similar to the Piper models. When these models came to EMBRAER, the Bandeirante had already started its production; that design technology was not the main motivation of EMBRAER . Although the agreement allowed EMBRAER to make modifications on the foreign partner designs, whenever necessary in order to make the aircraft more suitable for local conditions, very little has been done by the recipient country to modify the

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[222]Phase 8 requires that EMBRAER (Neiva) perform a portion of the manufacturing and most of the aircraft assembly. Piper said that it was the most unassembled condition that Piper has ever sold its aircraft [Ref. 6].

[223]The models selected were: Seneca 3, Saratoga, Turbo Arrow 4 and Archer 2 [Ref. 6].

original designs[224] [Ref. 8:p. 430]. In terms of production techniques, EMBRAER and Neiva have benefited more in volume of production, which reduced production costs, than the incorporation of new techniques. There is some evidence that, in terms of components and parts, both companies have increased the proportion of domestic content to 60%[225]. During this long term agreement no other evolution happened related to development and manufacturing of a new model, but if is evident that some component technology has been passed to EMBRAER and its subsidiaries and subcontractors. Because of this, it is valid to assign of medium to the type of technology in this case.

Q2) What is the technology transfer environment?

As was explained in the introduction of this section, the Brazilian government at that time (early 1970s) was creating new rules and establishing new **legal constraints** for the transfer of technology. The domestic-content requirement and no royalties payment clause were the Brazilian government actions in this period which directly affected this agreement. The "law of similars" was another tool used to allow COTAC to bar other international manufacturers entrance into the Brazilian market of general aviation aircraft [Ref. 3:p. 18].

The **competition environment** during this agreement negotiation was interesting. EMBRAER conducted negotiations with three companies: Beech,

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[224]The clause allowing EMBRAER to make changes in the original design was the main point of disagreement between Cessna and EMBRAER during negotiations.

[225]The acquisition of the kits in 1986 is an evidence of this improvement. Piper shipped detailed parts and components which represent only 55 to 60% of the value if it would be sent completely [Ref. 3:p. 18].

Cessna, and Piper. Beech dropped out quite early, taking a contentious position that if Brazil wanted its aircraft, it would have to import them from the U.S. EMBRAER had a particular preference for Cessna because it enjoyed wide recognition and confidence within the country, and it had a large market share and effective distributorship system[226]. Cessna's initial position was to release technology and managerial control to EMBRAER, but some differences arose during negotiations, and Cessna's ultimate position was negative. Two points were basically the source of this disagreement. First, Cessna refused to grant EMBRAER autonomy to make modifications it deemed appropriate in the Cessna aircraft models. Second, EMBRAER wanted no royalty obligation for manufacturing know-how acquired from the foreign partner. As a result, Cessna dropped out and Piper was selected[227].

The protection policies imposed by the Brazilian government just one year after the agreement was another important factor which affected directly the success of this agreement. In 1975, the Brazilian government imposed a 50% tax (raised from 7%) on imported small-size aircraft, and it also required the full deposit price of each plane for one year without interest. This agreement effectively closed the door to further imports[228]. In 1974, the Brazilian market for light aircraft was the

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[226]At that time Cessna held over 60% of the Brazilian market.

[227]Cavu, Cessna's Brazilian distributor, reacted with a proposal to the government to assemble two Cessna models plus their engines, but it was turned down [Ref. 9:p. 185].

[228]In 1973, Cessna sold more than 400 aircraft in the Brazilian market, but sold only 5 in 1976.

single largest export market for U.S. general aviation manufacturers. This fact, established as result of a market study by the Brazilian government, was sufficient to justify the import substitution of these aircraft.

The Piper case is considered to have one of the best transfer environments, although the technology involved was not very significant. This variable is graded as high.

Q3) What are the recipient firm's characteristics?

In 1974, EMBRAER had six years of operation and it had three lines of aircraft production: the Bandeirante (EMB-110), the Ipanema (EMB-201) and the Xavante (EMB-326). At the end of that year the company employed 3500 people and had a total capitalization of about $41.6 million [Ref. 10]. The only previous experience in licensing agreements was then with the Italian company, Aermacchi, to produce the Xavante. The international market at that time was not the main concern, because the company was overloaded with domestic air force and civilian airline orders. During this period of the company expansion, it was clear that the Piper agreement was one more challenge but required more labor-intensive work than research and development.

Since March 1980, EMBRAER has shifted the Piper models to its subsidiary Indústria Aeronáutica Neiva SA (Neiva) in Botucatu, São Paulo. The company was formed in 1954 and has a factory area of 23,515 sq mt, a work force of 516, and completed the 2000th aircraft in November 1987. Neiva which had been producing the fuselage for the EMBRAER's Ipanema, assumed complete control of that program in the second half of 1981. The company also has been

entirely responsible for Ipanema engineering, manufacture, and assembly and for the production of subassemblies for the EMBRAER Tucano [Ref. 10:p. 17].

The fact of EMBRAER shifting the responsibility for Piper models appears to be strategically important for the company in order to execute other programs more effectively. The divisionalization approach has been a constant in EMBRAER's strategy, which leads to decentralization without losing control.

EMBRAER capacity to technologically manage the Piper program since the early years after its creation, and the actual capacity to technically manage more complex programs, shows that the company takes a ranking of high on this dimension.

Q4) What are the suppliers firm's characteristics?

Piper Aircraft Corporation is now located in Vero Beach, Florida[229]. Besides the EMBRAER agreement, Piper has agreements with Chincul S.A. (Argentina), PZL Mielec (Poland), and Aero-Industrial Colombiana - AISCA (Colombia) [Ref. 11].

The relationship of Piper with EMBRAER has been excellent during more than 15 years of agreement. Mutual respect, a frank approach, and flexibility on a number of levels have been the main ingredients of this long relationship. For instance, Piper readily agreed with the EMBRAER need for authority to modify the chosen models for better fit into Brazilian airport conditions. At the same time, any

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[229]In March 1984, the company became a subsidiary of Lear Siegler, Inc. The previous manufacturing and R & D facilities at Lock Haven, Pennsylvania were closed and a new manufacturing facility (12,077 sq mt) is now concentrated at Vero Beach. In May 1987, the company was acquired by a California businessman.

modification in its know-how for these models' production was automatically transferred to the Brazilian partner through documentation sheets and specifications. Two formal meetings are held annually in EMBRAER and Piper plants alternatively, in which the problems are worked out.

The long-term relationship between Piper and the numerous other companies besides EMBRAER is evidence of a good technology transfer strategy, and the company managers' abilities in using this strategy to define markets in a very competitive environment. Piper as a supplier was graded as high.

Q5) Will this technology be integrated?

Production capability for the Piper models has been transferred to EMBRAER in three phases. During **Phase I**, completed structures such as fuselage, empennage, and wings were shipped to EMBRAER for final assembly and installation of all systems and components This phase was completed at the first six months and included only single-engine aircraft. At **Phase II**, EMBRAER received structured subassemblies for mating in jigs in addition to the functions achieved in Phase I. **Phase III** was divided into three subphases: (1) to begin replacement of Piper-supplied parts by Brazilian-made equivalents, including interiors and 50% of both fiberglass and acrylics; (2) to complete replacement of all remaining fiberglass and acrylics and produce all harnesses; and (3) to produce the aircraft completely with Brazilian-manufactured parts and components, with the exception of those that cannot be economically produced in Brazil. Upon the completion of the last phase it was expected by EMBRAER that 66-70% of the

Piper aircraft product would be made in Brazil. To support all these phases, Piper engineers have provided on-site training and technical assistance.

Under the first stage of the agreement, Piper sent complete kits which EMBRAER simply assembled and painted. During subsequent stages, EMBRAER made some design changes and progressively substituted Brazilian-made parts for the U.S. components. By the end of 1978, all the parts were of Brazilian origin except those whose local production would have been "uneconomical because of the small number involved" [230] [Ref. 4:p. 50]. Although EMBRAER at that time was developing rapidly and very busy, the company was confident of its technical capabilities. Therefore, the Piper aircraft series didn't seem so difficult at that time to incorporate technologically.

One of EMBRAER's strategies was to incorporate technology through subcontracting specialized work of other EMBRAER-affiliated aircraft companies. It was reported that Piper also provided technical assistance to these component supplier industries.

It was reported at the beginning of the agreement that EMBRAER produced aircraft suffering from low-quality interiors. The materials utilized did not hold up under hard use and to reach international markets it was necessary to send the planes for U.S complementation. It was known that EMBRAER absorbed technology and know-how very quickly. Although not fabricating many detail parts such as the engine, propellers, radios, and instrumentations, EMBRAER has been

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[230]The uneconomical parts and components that were not made in Brazil were acquired using Piper procurement from its own suppliers.

fully integrated into assembly of the aircraft kits, welding of airframe parts, some acrylic forming, all of the fiberglassing, all riveting, and nut and bolt assemblies. The local content of EMBRAER models averaged 45-50% in 1981, while Neiva averaged 40-45% [Ref. 13 and 3:p. 23].

The time element of technology integration was a very important component of the import substitution policy. In terms of skills, the company had to train new workers under the supervision of the more experienced people working in the Bandeirante and Ipanema lines. The level of employment required for this agreement was basically the assembly line laborers and the production engineers and technicians needed to supervise the line. The relevant aspect revealed in analyzing this variable is the economic feasibility of total integration in licensing agreements. Some components and parts were not produced domestically because of the insufficient market, and the option for buying them internationally was more rational. Taking into account all of the above considerations, the value assigned to the level of technological integration of the Piper agreement is medium.

Q6) Does this offset agreement conserve foreign exchange?

The idea of reducing the drain of foreign exchange by a local production of planes was the Brazilian government's main concern at that time. The agreement was the best solution for entering into production quickly and to avoiding additional development expenditures [Ref. 9:p. 185].

Between 1970 and 1974, Brazil imported 1900 small planes at a cost of $150 million in foreign exchange. It was estimated that if imports had continued at this rate, the country would have suffered an annual dollar outflow of $500 million

by 1977 [Ref. 4:p. 50]. Approximately 5% of country's total expenditures in 1973 went to the U.S. aerospace industry and this figure was even higher in 1974[231] [Ref. 1:p. 31]. At that time the country was severely pressured into foreign exchange constraints due to this situation.

Under the agreement, EMBRAER was not allowed to export Piper models directly. Restricted to the domestic market, EMBRAER Piper models produced in Brazil in 1976 cost 50% more than those produced in the U.S. [Ref. 3]. This figure dropped to 25% more by 1985. Table 14 shows the evolution of the Piper models production in Brazil.

TABLE 14

PIPER MODEL PRODUCTION (annual)

YEAR	75	76	77	78	79	80	81	82	83	84	TOT
QTD	131	352	408	148	195	283	147	93	50	83	1890

Source: Moxon, Richard and others, Emerging Sources of Foreign Competition of The Civil Aircraft Manufacturing Industry, The U.S Department of Transportation, June, 1985.

To complement the evidence of the import effectiveness substitution it was found that between 1976-1985, the same U.S. manufacturers delivered only 43 aircraft to Brazilian customers. It was evident that the import substitution model applied in this case to save foreign currency was successful. The foreign exchange variable was graded as high.

Q7) Does this agreement create jobs?

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[231] In 1974, the U.S. manufacturers delivered 726 planes to Brazil at a total cost of $600 million.

It was difficult to access this variable because the company did not divide its workshops by project, and the company was not able to provide detailed figures. However, using Table 15 which shows the evolution of employment in EMBRAER and Table 14 which shows the Piper model production, some estimates may be drawn. In 1974, EMBRAER contracted for 702 new employees. At that time, the company was working on the F-5 contract, the Bandeirante (production rate 4 a month), Xavante (2 per month) and Ipanema production. The Piper agreement started delivering only in the middle of 1975 [Ref. 12]. It seems that the main employment impact occurred in 1975-76. The company hired 902 employees (230 in 1975 and 672 in 1976)[232]. Considering that Phase I (6 months) and Phase II just required assembling and installation of some models, it was estimated that a great part of those new employees were hired for the assembly and material support to speed up the delivery of planes. The exact level of the labor increment is difficult to ascertain but the nature of the jobs conveys the conclusion that most of the new employees were hired as production line workers, material assistants, and mechanics.

Although this variable was not considered a fundamental motivation of this agreement, it was clear that the production of Piper models employed an amount of workers at the medium level.

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[232]These numbers increased in proportion to the volume production. The production in 1975 was 131 planes and increased to 352 in 1976 (See Table 14).

Table 15
EMBRAER EMPLOYMENT

YEAR	73	74	75	76	77	78	79	80	81	82
EMP.	2621	3323	3553	4225	4104	4300	4887	5957	5414	6732

Source: Moxon, Richard and others, Emerging Sources of Foreign Competition of The Civil Aircraft Manufacturing Industry, The U.S Department of Transportation, June, 1985.

Q8) Does this offset improve exports?

The Piper agreement did not allow EMBRAER to export Piper models directly. However, Piper agreed to place its international marketing network at EMBRAER disposal even for the Brazilian planes EMBRAER had modified [Ref. 4:p. 50]. Although EMBRAER might have used this facility to export planes, some experts pointed out that because EMBRAER was highly engineering-intensive it would be difficult to keep the costs down. Regardless of how well engineered an aircraft is, unless it is price competitive in the international market, it would not be a successful seller[233].

At the time of the agreement EMBRAER was deficient in marketing tactics, and this program was criticized by Brazilian dealers experienced in high-pressure international markets for being insufficiently aggressive in marketing its planes[234]. Besides, the Latin America market was sewed up by Cessna and Piper's other assembly programs. Argentina and Colombia had been selling aircraft to

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[233]The market at that time was dominated by Beech 100/200 and the Swearingen Merlin. Retail base prices of EMBRAER's Piper models average 27% above those charged by Piper in the U.S. Increases range from 17% from the Chieftain to 40% for the Arrow II [Ref. 2:p. 38].

[234]The first export of two Bandeirantes occurred only in 1978.

Venezuela, Ecuador, Peru, Bolivia, and Chile[235]. The African market at that time seemed too difficult to access. To market the Piper models abroad, the Brazilian government would have to suspend the tariff barriers, which would have increased the program's risk.

In May 1989 an agreement was announced between EMBRAER (Neiva) and Chincul to unify markets and to divide the production of Piper models between themselves. This accord would unify the Brazilian and Argentine markets and divide the production tasks[236] [Ref. 13].

Although EMBRAER has sold about 2000 Piper models in the domestic market, the prices of the aircraft are still kept above U.S. levels, and this has made further increases in local content uneconomical [Ref. 9]. The Brazilian market in recent years has been depressed, as it has been in most of the world, and the general aviation portion of EMBRAER business has suffered[237].

Because of the commercial export restriction, which was different from the "end-user" clause but with the same effect, and also because EMBRAER could not reduce the Piper models cost for competitive marketing, this variable was rated as low impact.

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[235]The Argentine's Piper distributor, Chincul Fabrica de Aviones SA (Buenos Aires) was created in 1972 to assemble and gradually increase the degree of local manufacture in some products. The company had incorporated more than 60% local manufacture. All Piper kits delivered for several years have been for phase 3 completion. The company has a plant of 16,500 sq mt, a work force of about 300, and had delivered more than 850 aircraft by May 1987 [Ref. 11].

[236]For example, the Argentine company would produce four-seats models and Neiva those of six-seats capacity [Ref. 13].

[237]By 1980, the Piper models accounted for 57% of EMBRAER's output [Ref. 9].

not reduce the Piper models cost for competitive marketing, this variable was rated as low impact.

Q9) Does this agreement obtain financial investment?

The financial part of this agreement is unknown. It appears that the government financial participation was only for purchasing some of the Piper models in order to incorporate the Air Force transport squadron.

Q10) What are the internal and external political motivations for this agreement?

When the agreement was signed, the major internal political motivation was to promote foreign exchange savings due to the first oil shock in 1973 when the imports burden increased fantastically. This motivation was observed mainly in the Ministry of Economy. Other political motivation came from the Aeronautics Ministry through its Department of Civilian Aviation (DAC). In 1974 the DAC enacted legislation[238] requiring that all requests for civil aircraft import licenses must receive prior approval from the Aeronautics Ministry Committee for the Coordination of Civil Air Transport (COTAC). The Brazilian government Foreign Trade Department cannot approve an import request without the committee's prior approval, which met once a month to examine such applications. The information required by the government in this process included the price of the aircraft, financing terms, delivery time, commission to be earned by the Brazilian agent, financial ability proof by the buyer to make the purchase as well as a justification as to why he needs to bring in an imported aircraft rather than using domestic airlines, air taxi or air

[238]See Decree-law 74219 of 25 June 1974.

charter services, affidavit from a Brazilian repair facility attesting that it can perform the necessary aircraft maintenance to be purchased, and finally an explanation for the reason why a comparable Brazilian-built aircraft was not being purchased, if it already existed. Although this "law of similar" approach is very strict, the buyer could still justify a small aircraft acquisition instead of the Bandeirante which its regulation basically tried to protect[239]. Because of the role of the legislation, the Aeronautics Ministry was looking for some effective way to cover this gap. The best solution to definitively close the alternatives in this legislation was the domestic production of small aircraft. The above explanation was provided to show one isolated motivation from the Aeronautics Ministry, but except for the technocrats from the economic sector, the other sectors seem to have had little participation. This variable was graded as medium.

Q11) How did this government act in this offset?

This cooperation agreement has been characterized as an illuminating example of how much a recipient company with strong government support can negotiate for better terms on technology transfer. Since the beginning, the government had been deeply involved in this agreement. The negotiations were originated in a Brazilian government mission when they came to the U.S. in order to attend a series of meetings with all the major small aircraft producers, and to solicit proposals for a production program. At the second phase of the negotiations, including just EMBRAER and the three U.S. companies, some EMBRAER officials explained only their technical, managerial, manufacturing , and

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[239]The legislation excluded all aircraft under 15,400 kg.

marketing needs, since the bidders had a clear notion of the "rules of the game" established by the Brazilian government[240].

The other great Brazilian government intervention was on the market protection implementation erasing the import tariff of small aircraft and creating the compulsory deposit. Another specific Aeronautics Ministry intervention can be seen in the aircraft import licenses approval process (see Q10).

In terms of technical support, the CTA has performed training and technical support in quality assurance through its fostering of the IFI institute.

Although the Government has not been directly active in this case, its intervention through issuing legislation for market protection, increasing the import tariffs, and also acquiring some aircraft units, provided enough support to rate this variable as high.

Q12) What are the political and social pressures of this agreement?

To adequate assess this question, the political and social pressures towards this agreement requires a detailed research of Brazilian sources and is beyond the scope of this thesis. However, some conclusions may be summarized from the secondary sources. The relevant and singular political pressure found in this agreement was the union between the technocrats from the economic sector, the obvious incentive of the industry, and the military, responsible for nurturing its infant aircraft industry. The sharing of the same objectives by these actors was

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[240]The basic rules were to reserve the Brazilian domestic market exclusively for Brazilian-produced aircraft (industry protection) to create foreign exchange savings. Implicit in this rule was the eventual outcome that only the foreign firm prepared to enter into an agreement with EMBRAER would be permitted to participate in the large Brazilian market.

one of the main reasons for the creation of an integrated strategy. The technocrats were concerned with the balance of payments for the first time being tremendously affected by increasing oil prices. The Aeronautics Ministry was concerned about using all possible ways to protect the industry. As a result, the Piper agreement came to fulfill these needs. Acknowledging the lack of complete and revellent data, it would be safe to assign a medium grade for this variable.

MILITARY FACTOR (industrial defense, international prestigious, military capability. an independence and non-vulnerability)

The analysis of the military factor in this case is not applicable.

OFFSET OUTCOME

The outcomes of the Piper case show interesting findings related to the technology transfer through commercial licensing agreements. In this case, the most important variables are the foreign exchange savings, the government action, and the transfer environment. These variables suggest that this type of offset is efficient in obtaining technology fast to reach the market, even if this market would be restricted to domestic sales. The Piper general results are shown on Table 19.

Q18) Does this agreement provide independent technological capabilities?

Although the type of technology transferred through this licensed production agreement had been considered relatively unsophisticated in relation to other EMBRAER agreements, this overall outcome is high because of the transfer environment, recipient characteristics, and supplier characteristics. Due to the medium level of the technology involved, both recipient and supplier were

perfectly compatible with this technology transfer process. Again, because of the level of the technology and its civilian characteristics, the transfer environment seems to be more commercial than political, making the process more flexible. The overall average for this outcome is high capability. See Table 16 for the complete results.

Table 16

CASE: PIPER	
VARIABLES	GRADE
Q17) OFFSET TYPE	LICENSED PRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	HIGH
Q3) RECIPIENT'S CHARACTERISTICS	HIGH
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM

OUTCOME

Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	HIGH

Q19) Does this offset improve Brazilian national security?

Because the Piper case is a civilian case it was not analyzed under the military factor. The socio-political factor, even partially evaluated, showed the integration of two different government sectors' goals into one overall strategy. Perhaps this may be one of the reasons why this variable deserves more emphasis in relation to the others. The result of the national security outcome for this agreement is medium. Table 17 shows the grades under this outcome.

Table 17

CASE: PIPER	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVES	MEDIUM
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	MEDIUM
Q13) INDUSTRIAL DEFENSE	N / A
Q14) INTERNATIONAL PRESTIGIOUS	N / A
Q15) MILITARY CAPABILITY	N / A
Q16) INDEPENDENCE/NON-VULNERABILITY	N / A

OUTCOME

Q19) ENHANCEMENT NATIONAL SECURITY	MEDIUM

Q20) Does this offset improve Brazilian balance of payments?

Almost all the sources that cite the Piper case emphasize this outcome as the main reason why the Brazilian government entered into this agreement with the U.S. company. The ability of this agreement to promote savings in foreign exchange, as it was demonstrated, is unquestionable. However, because of other factors such as the general aviation market, the prohibition of export, and the fierce competition in this sector, the result of this outcome was averaged as medium. Table 18 presents the results of this outcome.

Table 18

CASE: PIPER	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	HIGH
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	UNKNOWN

OUTCOME

Q20) ECONOMIC BENEFITS	MEDIUM

Table 19

CASE: PIPER	
VARIABLES	GRADE
Q17) OFFSET TYPE	LICENSED PRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	HIGH
Q3) RECIPIENT'S CHARACTERISTICS	HIGH
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM
Q6) FOREIGN EXCHANGE SAVINGS	HIGH
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	UNKNOWN
Q10) INT/EXT POLITICAL MOTIVATION	MEDIUM
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	MEDIUM
Q13) INDUSTRIAL DEFENSE	N / A
Q14) INTERNATIONAL PRESTIGE	N / A
Q15) MILITARY CAPABILITY	N / A
Q16) INDEPENDENCE/NON-VULNERABILITY	N / A

OUTCOME VARIABLES	GRADE
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	HIGH
Q19) ENHANCEMENT NATIONAL SECURITY	MEDIUM
Q20) ECONOMIC BENEFITS	MEDIUM

2. The Aérospatiale Military Helicopters Case

The Aérospatiale military helicopters case is a very recent offset agreement which involves the French and Brazilian governments and little information has been released by the companies involved[241]. The case is an example of a licensed production offset involving a government-to-government agreement[242]. The case is about the Brazilian Army acquisition of 52 military helicopters to equip the first airmobile battalion. The French Aérospatiale and its Brazilian partners HELIBRAS and ENGESA will be responsible for the equipment supply. Two things make this case different from other cases. First, this case is handled by the Army Ministry instead of the Aeronautics Ministry as the major government agency participant in this agreement. Second, there is a difference between HELIBRAS and EMBRAER related to their government support.

Q17) What are the offset agreement characteristics?

The Brazilian Army acquired 52 antitank and assault helicopters to operate in its first airborne cavalry unit in Taubaté, in São Paulo state. The contract awarded in February 1988 with the French company Aerospatiale was estimated at $246 million, and it included 16 AS-350L1 Ecureuil light helicopters, which are

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[241]A questionnaire was sent to a HELIBRAS's manager, who is responsible for the office inside Aerospatiale that establishes the connections between the Brazilian and French companies. The answers of this questionnaire has not returned yet, which is assumed that the content was considered proprietary. The information used to analyze this case was obtained by telephone conversation and periodical articles.

[242]According to the definition in Chapter Two, the government-to-government licensed production agreements are classified under the coproduction offset type. The decision to insert this case under the licensed production group is to facilitate the comparison between a civilian case (Piper) and this military one.

used for fire support and antitank missions, and 36 SA-365FK Dauphins for small commando team transportation [Ref. 1]. The first helicopter was scheduled to be delivered in November 1988, but it was only officially received on April 21, 1989[243] [Ref. 3].

It is not possible to ascertain the entire offset package for this agreement but it seems to have basically three parts. First, it includes the technology transfer of some components to various Brazilian companies. Second, it includes the assembly and test of the helicopters by HELIBRAS, the same company that has been assembling Aerospatiale helicopters in Brazil since 1978. Finally, the French government promises to buy at least 50 Tucano trainers for the French Air Force worth about $125 million [Ref. 4]. Although these three parts are all important, the discussion of this case will emphasize the HELIBRAS part which refers to the license itself.

The offset percentage is 100%. The time for implementation is 10 years [Ref. 5]. The method of enforcement is "best effort" [Ref. 4]. The financial arrangements and the inclusion of the "end-user" clause is unknown.

In summary, the Aerospatiale military helicopters case is basically a licensed production offset agreement which includes the transfer of some component technology. It also includes a countertrade package of EMBRAER planes, but this is not the focus of this analysis.

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[243]The first airborne battalion is located in Taubaté, São Paulo. The battallion is divided in three units based on the three types of helicopters: the troops transport unit, the reconnaissance and attack unit, and the instruction unit [Ref. 2].

Q1) What type of technology is being transferred?

The technology transferred under this agreement is divided in two types: the **component technology** and the **assembly and test technology**. The component technology is described in a "list of preferences" that seems to be included as an annex in the main contract. An example given was the components transfer of the Omega turbine between the French Thomson company and one Brazilian company not identified. Another example included the transfer of simulators technology to the Brazilian company Aeromot[244] [Ref. 5]. The assembly and test technology transfer is directed to HELIBRAS, which is also responsible for maintenance and technical assistance, because the Army does not have this structure yet. This last part does include the transfer of a small amount of production helicopter technology to HELIBRAS[245].

Summing up, the level of component technology is unknown because the various subcontracts have still to be negotiated. The assembly and test technology and the small share of fabrication technology transferred to HELIBRAS is not considered as significant. The technology benefits of this agreement rest on the future benefits in having various industries producing helicopter components

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[244]Aeromot is a private Brazilian company group that is dedicated to the aviation industry. The group is now active through its three companies: Aeromoto Aeronautica e Motores S.A (complete service to general aviation needs), Aeromoto Indústria Mecânico-Metalúrgica LTDA (structural components), and Aero-Eletrônica Indústria de Components Aviônicos LTDA (design, development, and production of electrical and electronic equipment, with various made for EMB-312 Tucano and AM-X aircraft usage) [Ref. 7].

[245]The production share that will be undertaken by HELIBRAS is some 5% of Dauphin fabrication [Ref. 6:p. 15].

and parts and the relative low level of technology transferred to HELIBRAS. The technology is graded as medium in this case.

Q2) What is the technology transfer environment?

The Brazilian government is investing once more in the transfer of helicopter technology in Brazil. Since 1978, HELIBRAS has been the basis for the national helicopter industry. However, the company has had problems and it has not reached the expected objectives[246]. Although the Brazilian government has applied similar methods of protection in helicopter imports as it did in general aviation, the domestic market seems to require products with technical specifications above the level that HELIBRAS can produce. The same kind of problem seems to happen to the service orders. The Brazilian Air Force (FAB), followed by the Brazilian Navy and recently the Brazilian Army, has specified military helicopters with technological requirements greater than the actual equipment which has been manufactured by the domestic company. The external market has been restricted to a very few sales to neighboring countries[247]. In terms of protection and support by the Brazilian government, no direct evidence was found, but because HELIBRAS has not been under the federal government's arm but under state government support since its creation, and with strong foreign

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[246]The first agreement estimated that the level of domestic content would reach 70% and HELIBRAS has only incorporated 30% of local manufactured items and the majority of the company work involves pure helicopter assembly kits imported from France [Ref. 6:p. 15].

[247]HELIBRAS has sold a total of 21 helicopters to Latin American countries such as Bolivia (7), Chile (1), Argentina (1), Bolivia (4), Venezuela (3), and Paraguay (5) [Ref. 8].

participation[248], it seems that the federal government is giving this company different treatment than the rest of the aircraft industry.

Another important point to be discussed under this variable is the competition generated in the Brazilian Army international bid. The competitors include Italy's Augusta[249] (with A109), Bell (Supercobra) and Sikorsky (Black Hawk) from the U.S., Germany's Messerschmitt-Boelkow-Blohm (MBB - with BO-105) and Britain's Westland (equipment unknown) [Ref. 10]. The Brazilian Army technical and offset requirements are unknown, but it seems that Aérospatiale exerted a lot of influence in this selection process. Since the company has worked for a long time to expand its market in South America, this agreement sounded like a "premium" opportunity to work with HELIBRAS for many years to come. Other evidence that showed this competition was fierce is the impressive number of helicopters required by the Brazilian Army. The Army estimated 260 helicopters to outfit three airmobile battalions, a significant number which would cause disturbance in the helicopter market[250]. It becomes easy to see the influence of this

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[248]Aerospatiale still owns 45% of the HELIBRAS shares since the creation of the company in 1978.

[249]This company has signed on 23 July, 1989 a license agreement with the Argentina government and Fabrica de Argentina de Materiales Aerospatiales (FAMA). The agreement is worth $120 million and it includes the construction of the fuselage and the final assembly by FAMA. The helicopter is the same A-109 offered to Brazil, and the production run is estimated to be 600 units [Ref. 9].

[250]The overall long term requirement was estimated at 500 helicopters. This was to equip several battalions each with 36 troop carrier helicopters, 16 armed scouts, and an unspecified number of trainers and utility units [Ref. 11:p. 47].

competition in improving the offset package, certainly the main consideration in making this agreement.

The last point viewed in this question is about the previous technology transfer process offered by Aerospatiale. Based on the previous agreements, it is estimated that the transfer environment would much influence in improving the technology transfer. The level of technology content that Aerospatiale promised in previous agreements has yet to be completely implemented.

In conclusion, the Aerospatiale and Helibras problems in fulfilling previous agreements, the insufficient market, and the apparent difference in government support leads to a pessimistic technological environment. However, it is expected that the Brazilian Army has a strong interest in succeeding in its first initiative to become more independent from the Air Force in a operational sense. The best evidence of this Army motivation has been the offset package obtained through a very structured international competition. Another favorable point in this case is that ENGESA now holds 55% of the HELIBRAS shares, which may improve the technical and administrative development of the company [251]. It seems fair to assume this variable as of medium influence in this case.

Q3) What are the recipient firm's characteristics?

HELIBRAS has had a turbulent development since its creation. The company constant changes and the lack of commercial ability to select helicopter models more adequate to Brazil's conditions and needs are the main weakness.

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[251] This is a new factor in relation to the previous contract when the Government of Minas Gerais was the major shareholder. ENGESA is also a major armored cars supplier for the Brazilian Army [Ref. 12].

The lack of credibility held by various government sectors made the company mainly responsible for the lack of domestic helicopter production in Brazil.

HELIBRAS, since its creation in 1978 has assembled about 100 Aerospatiale helicopters, most for sale in Brazil. The technical absorptive capacity of the company seems to present some problems such as the lack of R & D connected with the transfer of French technology. Recent articles show that the company is not doing well in having some of the components nationalized. It was not possible to ascertain the level and make-up of its production and R & D force, but it seems to emphasize technicians more than engineers, because of the assembly work that is being done.

The domestic market for helicopters has been affected by the economic situation. HELIBRAS helicopters have been sold mostly to the Air Force, Navy, and Brazilian Police evidence that the helicopters produced are sophisticated in relation to the private companies' needs[252]. The international market also presents a pessimistic picture for a developing country's industry to compete worldwide.

The HELIBRAS technical absorption problem seems somewhat complex to be solved in a short term. The domestic and international market shares seem constant. This realistic picture leads to evaluating the recipient company characteristics as an unfavorable low.

Q4) What are the suppliers firm's characteristics?

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[252]The helicopters produced by HELIBRAS are relatively larger (e.g., Ecureuil has six-seats) than for a normal customer [Ref. 2].

Aerospatiale is a French government-owned company formed in January 1970 as a result of the merger of Sud-aviation, Nord Aviation, and Sereb. The company covers an area of 2,005,674 square meters and has a staff (including subsidiary companies) of 38,800 persons as of 1 January 1987. Its activities are devoted 32% to fixed-wing aircraft, 19.3 % to helicopter, 32% to tactical missiles, 16.4% to ballistic missiles and space, and 0.3% to other works. By December 1987, the helicopter division had delivered 7,476 units of French design plus 328 assembled under license. Besides the financial participation in HELIBRAS, the company also takes part in Samaero (Singapore) and Maroc Aviation (Morocco). The company has a tradition of being aggressive in exports and has developed considerable expertise in handling offsets[253]. Specifically in Brazil, the company has won contracts based on its offset packages[254].

Aerospatiale has worked long and hard and with considerable French government help since its first contract. In 1978, it became an expressive shareholder (with 45% of the shares) in the Brazilian company in order to have its proposal approved. The financial investment made by the company in Brazil has suffered from continuing lean sales, which seems the company offset for this big

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[253]In 1985, Aerospatiale was the world's leading helicopter exporter. In this same year, the Brazilian government bought the Super Puma for the Air Force and Navy and some Ecureuils for the Navy. At that time, the Super Puma was the largest and most expensive machine of the company [Ref. 13].

[254]In 1978, Aerospatiale sold helicopters to the Brazilian Navy in exchange for foreign investment and for the French government acquisition of Bandeirantes. In 1985, it sold the Super Puma helicopters in offset for 41 EMBRAER Xingu. In 1988, once more the company used the French government's promise to buy 50 Tucanos as an offset package.

contract. In this agreement, which involves as many as 370 transports, armed scouts and training utility helicopters, it seems that the company really put a lot of efforts into sustaining its position in Brazil[255]. France has an important presence throughout South America but in no single foreign country does it have a foothold as the major aerospace supplier. One of the main reasons for this success has been the constant U.S. embargoes that have stymied the U.S. helicopter industries in marketing products, due to a belief that available funds in South America should not be spent on arms[256].

The capacity of Aérospatiale to utilize offset as a tool for negotiating export sales is counterbalanced by the lack of rigor in implementing them. The Brazilian government has various motives for negotiating a new agreement with its old supplier, but for the purposes of this analysis, Aérospatiale is graded as medium contributor to this agreement.

Q5) Will this technology be integrated?

There are two views in analyzing this variable, one optimistic and the other pessimistic. The optimistic sees HELIBRAS as a completely different company than in the first agreement. The main considerations are the ENGESA factor and the Army factor. The ENGESA factor is evidenced by the technological level and the diversification strategy of this company. ENGESA is known worldwide

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[255]The exact total number required is controversial. Some sources include the total acquisition of 254 utility and 112 reconnaissance/attack helicopters [Ref. 14]. Other sources estimate an overall requirement of 500 helicopters [Ref. 11:p. 47].

[256]This has not been a general rule. Many Latin American countries have U.S-made helicopters. The Brazilian Air Force has purchased helicopters from Bell and Sikorsky.

to carry a label of simplicity in the operation of its equipment. This company's philosophy may help HELIBRAS to find out a way for simpler and cheaper helicopter production. The ENGESA diversification is a lesson of surviving through a difficult economic situation in Brazil. ENGESA, manufacturer of armored vehicles such as Cascavel, Urutu, and Osorio, is now investing in helicopters (HELIBRAS) and in rockets and missiles (ORBITA). HELIBRAS has also diversified into other fields such as the agriculture application of helicopters. The Army factor is also important, since it results in more governmental support for the industry.

The pessimistic view results from analyzing other factors in the framework such as: time, skills, and the service sector. The time for integration in this case is important to show the company's responsibility in following the agreed upon schedule. The skills required for the integration of this technology are another critical point. The company has the huge task of training the Army personnel in different levels of maintenance and material control, but the company does not seem to be prepared for this task since its staff is constituted basically by technicians and laborers. The performance of the service sector is also a consequence of the skills. This time the company will certainly require both technical and administrative personnel to support this agreement. Splitting the difference between these two views results in a value of medium.

Q6) Does this offset agreement conserve foreign exchange?

The conservation of hard currency in this case is very complex if all three types of offset components packages are considered. It is clear that the $125 million purchase of Tucanos will be considered as a counterpurchase by the

French Air Force instead of a simple barter, without any exchange of money. The other option that includes the gradual substitution of foreign for indigenous components may be classified as a long term savings. Finally, some contract arrangements may be agreed between the parts and would include the payment for the assembly and test in cruzados which would save some hard currency. The last hypothetical situation also seems rational, that the French Banks avoid financing the acquisition under a countertrade condition like this.

The real terms of the offset package exchange implementation are unknown but the assumptions above support a low grade being given to this variable.

Q7) Does this agreement create jobs?

The creation of new jobs motivated by this agreement is expected to be great. The first impact will be in HELIBRAS. In 1987 the company employed 350 people. The second impact will be in the component suppliers. It will be a slow process because of the willingness of the private company to invest in an increase in its capacity just for one government contract that may be cancelled unilaterally without compensation. The last impact will be in EMBRAER, but in this company the sales of Tucanos will only represent the support of the personnel capacity already installed. These considerations result in this variable being rated as medium.

Q8) Does this offset improve exports?

Based on the first agreement and the actual situation of the international market of helicopters, it would be assumed that this variable won't lead to good

export results. Historically, HELIBRAS has demonstrated a low market penetration even in the Latin American countries. The African market seems to be dominated by the Europeans and also by the U.S.. One possible strategy would be dedicated to making tough, cheap, and a high payload capacity type of helicopters. This would expand the market to customers interested in carrying offshore oil rigs or transporting goods to isolated mines scattered in dense forests [Ref. 2]. The international market is very competitive and entry in this market may occur through reducing the production costs where the Brazilian companies have economies of scale. There is no multinational helicopter manufacturer in the Latin America market and this may lead to the creation of "an EMBRAER for helicopters" [Ref. 2]. However, the reality is very well expressed by a comment from the EMBRAER's chairman, Ozilio Carlos Silva, "the market does not justify the investment in helicopters in Brazil". This perhaps is the reality of what the helicopter industry has to deal with in the future.

Because of the weak helicopter market conditions this variable is graded as low.

Q9) Does this agreement enhance the financial viability of the project?

The financial arrangements of this case are unknown. However, it is clear that the French government has used its government and commercial banks to finance this entire project. The countertrade of Tucanos may provide some interim finance and payments spread out for a certain period.

Q10) What are the internal and external political motivations for this agreement?

The political motivations of this case were not completely assessed but some assumptions may be drawn. The **internal political motivations** of this agreement have come from various levels of the Brazilian government and society. Since the creation of HELIBRAS, the company has been under the control of the state government of Minas Gerais. This condition has exposed the company to more political maneuvers and influences than if it had been under the military ministers. The commercial and technical failures of HELIBRAS have instigated a new federal government policy to establish definitely, according to the Aeronautics minister Brigadier Octavio Moreira Lima, an "EMBRAER for helicopters". It means a new company, a new plant, and also a new structure. The new company would have a "tripod" structure, with share control divided equally among the government, private Brazilian capital, and a multinational company[257] [Ref. 2].

The external political motivations of this agreement refer to the difference between the French and the U.S foreign policy in arms transfers. The argument that U.S restrictions on arms sales is contributing to other suppliers such as France expanding their market share in countries previously under U.S influence. This case is the third bid in 10 years that the U.S. company is not the winner, which caused

[257]This structure is very common in the Brazilian petrochemical industry which avoids the danger of domination either by the State or by a foreign company [Ref. 2].

a furor among the U.S. industries, because of the "surprises" that happened in these competitions[258].

This variable may be discussed more deeply, supported with more research, but the facts are sufficiently evident that there is a high political motivation in this agreement.

Q11) How does this government act in this offset?

In this particular agreement, the government has been very active. The Brazilian Army apparently conducted all the negotiations actively. Some evidence shows that the Aeronautics Ministry had supported the Army in establishing the technical requirements because of the Brazilian Army inexperience with the equipment and its logistics [Ref. 5]. The Brazilian government had put pressure during negotiations for the technology transfer, which probably handicapped Black Hawk (Sikorsky) due to the Pentagon's restrictions on re-export of American weapons [Ref. 10][259]. The other kinds of government support for this agreement are unknown in detail, but it seems that the government may use resources such as GFE, facilities, transportation, etc as an incentive for this agreement.

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[258]In 1985, when the U.S. companies Bell and Sikorsky were still negotiating the agreements, the Planning Minister Antonio Delfin Neto, unexpectedly announced a $170 million deal for the purchase of 40 Aérospatiale Super Pumas. This fact had caused a lot disagreements, which only subsided later in the year with a renegotiation of the deal during the French President's visit to Brazil in October [Ref. 2]. Other comments brought up related to the previous position of the minister Delfin Neto as Brazilian Ambassador in France.

[259]The French bid was supported by a total absence of limitations on the re-export business, according to Jose Luiz Whitaker Ribeiro, president of ENGESA [Ref. 10].

Because of the special Brazilian Army interest in the success of this agreement, which means the success of the first airborne unit, this variable is rated as high.

Q12) What are the political and social pressures of this agreement?

The political and social pressures in this agreement also were only partially known. The leverage power of ENGESA and EMBRAER companies, the two "big ones", in this agreement is the main factor that might exert some pressure towards the choice of Aérospatiale. The companies' interests, although different, coincided in this agreement. EMBRAER's interest is expressed by the opportunity to sell Tucanos. ENGESA's interest is expressed by the opportunity to continue to survive financially, when the armored vehicle business shows signs of slowdown with the cease fire between Iran and Iraq, directly affecting the sales of the other part of the company. ENGESA particularly used its relationship with the Brazilian Army to influence this solution. Another factor which may have exerted considerable influence was the Aeronautics Ministry losing its supremacy in air support since its creation in 1941[260].

Even partially evaluated, this evidence point to the political weight that pressured the decision-maker toward the Aérospatiale option. Because these pressure factors had the leverage to shift the decision-making process in this case, the grade attributed to this variable is high.

Q13) What are the benefits of this agreement for defense industry?

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[260]The Aeronautics Ministry was formed from an aviation division of the Brazilian Army.

The helicopter ventures in Brazil have been adding very little to the Brazilian defense industry. For many reasons pointed out before, HELIBRAS is criticized as mainly responsible for this failure. Although applying some of the same procedures previously applied to EMBRAER, other considerations such as insufficient markets and administrative problems have prevented this company from reaching the established objectives. Although this contract has a different environment in relation to the first one, it seems that the structural problems such as overemphasis of service equipment requirements and the relatively simple civilian company requirements for operating in Brazil still affect the value assigned to this variable. Assuming that this agreement may bring new results, the variable is graded as medium.

Q14) Does this agreement bring international prestige?

If Brazil were successful in the export of the military and civilian versions of the Aérospatiale helicopters, it would have been easy to assume a high value for this variable. But this has not happened. The production of helicopters under license in Brazil definitely has brought a low psychological perception of the prestige for the Brazilian aerospace industry.

Q15) How does the technology embodied in this offset improve the national military capability?

The operation of helicopters by the army is a concept that has been successful in numerous battles in Korea, Vietnam, Middle East and Malvinas. These conflicts demonstrated the importance of the helicopter as a factor which

can multiply the force of commandos and serve as an option for troop tactical transports or as an important arms platform [Ref. 15].

Considering the importance of the Brazilian Army innovative airmobil concept and its contribution to the military capability, especially the jungle units, this variable is considered as high.

Q16) How does this agreement contribute to the country's independence and non-vulnerability?

The independence goal is reflected in this case as the capacity to produce helicopters with 100% of domestic content. In vulnerability in this case is intended by obtaining the capacity to maintain the supply of helicopter spare parts in cases of conflict or embargoes of any nature. The Aérospatiale agreement does not seem effective to attend the independence goal, but it seems to attend the vulnerability concept, considering the relationship between Brazil and France and the French foreign policy in arms transfers. The superficial analysis of this variable shows that a medium grade is warranted because of the intermediate position between these two concepts.

OFFSET OUTCOME

The outcome variables of this case are very important in demonstrating the importance of government-to-government agreements in relation to license agreements between companies.

These kind of licenses are ones in which the governments are deeply involved in most of the process, the criterion for decision-making in recipient countries being driven by the political and national security concerns instead of

economical ones. The technological capability is also a secondary variable which most of the time is considered irrelevant by the recipient government but is heavy considered by the recipient countries. The case general results are presented on Table 23.

Q18) Does this agreement provide independent technological capabilities?

The Aérospatiale case is marked by a relatively good transfer environment and supplier characteristics, but less variable because of the recipient characteristics and its relatively low capacity to integrate the technology transferred. Although Aérospatiale had the capacity and interest as owner to transfer the technology to Brazil, HELIBRAS has not responded well to this initiative. The same structural problems existing since the first agreement in 1978 seem to continue in this agreement. The new ENGESA factor may ameliorate the technological conditions of this agreement with its expertise and philosophical concepts towards the simplicity and inexpensive equipment that have contributed to its success in the third world market. The technological capability outcome of this case is graded as medium, considering that this intermediary position is prevalent in most of the independent variables. Table 20 shows the results of this outcome.

Table 20

CASE: AÉROSPATIALE HELICOPTERS	
VARIABLES	GRADE
Q17) OFFSET TYPE	LICENSED PRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	LOW
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	MEDIUM

OUTCOME

Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM

Q19) Does this offset improve Brazilian national security capability?

The national security outcome is always expected to be as high in government-to-government agreements that include the transfer of military technology. This case is a good example of the significant political maneuvering and influence attempts in cases of this type. Aérospatiale's influence on the Brazilian government decision is obtained through methods such as direct investments and offsets, the influence from industries such as EMBRAER also played a role. The new military airborne Brazilian Army concept seem in this case represents an evolution of the Brazilian military, perfectly adapted to the external threat perception in place of the idea formerly prevalent of combating only the internal guerrillas. Table 21 shows all the resuts under this outcome.

Table 21

CASE: AÉROSPATIALE HELICOPTERS	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVES	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	MEDIUM
Q14) INTERNATIONAL PRESTIGIOUS	LOW
Q15) MILITARY CAPABILITY	HIGH
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM
OUTCOME	
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH

Q20) Does this offset improve Brazilian economic capability?

The economic analysis of this kind of offset which involves serious national security aspects is very difficult because of the lack of information about funds and financial credit lines available for the purchaser country. This secrecy does not allow a cost/benefit analysis by the public to justify the choice made among the various proposals. This case is evidence that a low economic impact is expected, based on the four independent variables partially analyzed. The economic benefits outcome is explained on Table 22.

Table 22

CASE: AÉROSPATIALE HELICOPTERS	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	UNKNOWN

OUTCOME

Q20) ECONOMIC BENEFITS	LOW

Table 23

CASE: AEROSPATIALE HELICOPTERS	
VARIABLES	GRADE
Q17) OFFSET TYPE	LICENSED PRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	LOW
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	MEDIUM
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	LOW
Q9) ENHANCE FINANCIAL VIABILITY	UNKNOWN
Q10) INT/EXT POLITICAL MOTIVATION	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	MEDIUM
Q14) INTERNATIONAL PRESTIGE	LOW
Q15) MILITARY CAPABILITY	HIGH
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM

OUTCOME VARIABLES	GRADE
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH
Q20) ECONOMIC BENEFITS	LOW

D. COPRODUCTION

This last section shows two examples of coproduction/codevelopment offset agreements. The first agreement is the international coproduction agreement between Brazilian and Italian governments, involving various industries in both countries, to jointly develop and produce the AM-X, a subsonic combat aircraft. The second agreement is also an international commercial agreement between EMBRAER and FAMA (Argentina) to jointly develop and coproduce a 19 seat commuter aircraft. Both examples illustrate the difference between civilian and military agreements, focusing on the government participation and technology transfer process.

1. The CBA-123 PARANÁ Commuter Plane Case

This case describes an example of coproduction between the Brazilian and Argentine governments to codevelop and coproduce a 19-seat commuter aircraft[261]. The CBA-123 Paraná case involves the Fabrica Argentina de Materiales Aerospatiales (FAMA) and EMBRAER[262]. The case shows a very interesting phenomenon of aerospace technology transfer between two developing countries. The information collected for this case came from various articles of specialized aviation magazines, Latin American studies periodicals, and also from telephone

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[261]This case was difficult to classify under the OMB definitions in Chapter Two which emphasize military offsets. The author assumed that this classification may be used considering that the aircraft could have a military version.

[262]The acronym CBA means, "Cooperation Brazil-Argentina". The aircraft is named Paraná for the river flowing through both countries [Ref. 1].

conversations with EMBRAER staff. Some answers include a short background about the Argentine arms industry, with special focus on FAMA[263].

Q17) What are the offset agreement characteristics?

Brazil and Argentina are due to begin production of the CBA-123 19 seat commuter aircraft in 1991. The aircraft is the subject of a collaborative agreement signed by EMBRAER and FAMA in January of 1986. The agreement gives EMBRAER a 70% share in the project and the FAMA 30%[264]. The official contract for the whole project was signed on May 21, 1987 by Argentine Air Force Chief of Staff Brigadier General Ernesto Crespo, Brigadier Ruben Corradetti, the director of the Cordoba Air Force plane factory, and EMBRAER President engineer Ozílio Carlos Silva [Ref. 9]. The project's development cost is estimated to be about $300 million [Ref. 10]. According to the previous plan, the first flight is expected in December 1989 and the first deliveries start in 1991-2[265][Ref. 12]. The EMB-123[266] is a twin-engine (1200 HP) turboprop aircraft projected to have a range of 600 nautical miles, a practical ceiling at 35,000 feet, a speed of 650 Km/hour, and a maximum payload of 2,160 kg [Ref. 13]. The suppliers that participated in the bid

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[263]The main information sources about the Argentine arms industry, foreign policy, and national security were Katz [Ref. 2], Milenky [Ref. 3 and 4], Hilton [Ref. 5], Millán [Ref. 6], and Selcher [Ref. 7].

[264]Some sources estimated that the Brazilian Air Force has a 40% share in this project, which narrows the EMBRAER participation to only 30% [Ref. 8]. However, this information was not confirmed by EMBRAER.

[265]According to an EMBRAER estimate, the date for the first flight was extended to March 1990 [Ref. 11].

[266]The aircraft has two designations. For EMBRAER it is called EMB-123, and for FAMA it is known as IA-70.

for the engine were the Canadian Pratt & Whitney (with the engine PW400/1), the U.S. Garret (TPE331-16), and General Electric (CT9) [Ref. 14]. The Garret engine was selected because it can afford the aircraft a high rate of climb and altitude performance in addition to other technical advantages [Ref. 15]. EMBRAER and FAMA forecasted a market for 500-600 aircraft and an estimated price of $3-3.5 million[267][Ref. 18].

Q1) What type of technology is being transferred?

The EMBRAER-FAMA worksharing negotiated is also divided into 30% for FAMA and 70% for EMBRAER[268]. The companies agreed that EMBRAER will design, develop, and manufacture the forward fuselage, a portion of the center fuselage, wings, flaps, ailerons, ground spoilers, spoilerons, and rudder. FAMA will furnish parts of the central and rear fuselage including dorsal fin and vertical fin fairings, the tail cone, vertical fin and fairings for the horizontal/vertical fin junction, stabilizers and elevators, and engine pylons [Ref. 20]. The aircraft is a shortened version of the EMB-120 Brasília fuselage, and will share approximately 60% commonality of components, including almost the same flight deck, as well as common maintenance and cabin crew procedures. The technological innovations of this plane are a new supercritical wing, a T tail, and two rear mounted propfans with scimitar propeller blades. Because of this combination of new features, the

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[267]The companies are also expecting that the Brazilian and Argentine governments will acquire 36 units each [Ref. 16]. Another source has presented an estimated price of $4-4.5 million, based on options already received [Ref. 17].

[268]It is supposed to have two assemble lines, one in an EMBRAER plant and the other in a FAMA plant [Ref. 19].

CBA-123 is expected to offer fuel efficiency and speed, as well as an extremely smooth and quiet ride. There will be three prototypes constructed, two by EMBRAER and one by FAMA [Ref. 19].

The technology innovation applied to the design and production of the aircraft has been basically generated by EMBRAER. FAMA, although responsible for a small part of the production of the aircraft, already has the capacity to produce its share alone, which means that very little transfer of technology would occur from EMBRAER to FAMA and vice-versa. Considering the balance between the technological level of both companies and their experience in the production of turboprops, and the little amount of technology that would be exchanged, the grade for this variable is medium.

Q2) What is the technology transfer environment?

In order to answer this question some background is needed. The Argentine aircraft industry has been the most important arms production sector from the military, technological, and industrial point of view [Ref. 6:p. 40]. During the Perón era (1950s), an ambitious aeronautical programe was started. For a short period, the Air Force attempted to design and fly several types of jet fighters using British Rolls Royce engines made under license[269] [Ref. 4]. However, by the 1960s, the "fighter policy" changed to concentrate on transport and

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[269]The most ambitious projects, involving plans for quantities of jet fighters and large transport aircraft, were headed by foreign designers: Italian, French and West German [Ref. 6:p. 41].

counterinsurgency aircraft[270]. Before the Malvinas war Argentina was hoping to arrange future aerospace technology transfer arrangements with the U.S. But when the U.S. sided with the United Kingdom, this hope was at least temporarily dashed. When the war finished, Argentina looked for European assistance, but the war caused European countries to continue constraining the transfer of technology. This put the Argentine aircraft industry in a position farther behind than it was before the Malvinas war. Like Brazil, Argentina's aircraft industry also has deficiencies in technologies such as avionics and jet engine design and production[271][Ref. 2:p. 65]. However, the Argentinians seem to have implemented some technology in composite materials and production management[272]. In summary, Argentine technological transfer in the aeronautical environment has been affected by constant governmental policy changes, ranging from strictly

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[270]The change in policy was due to inter-service rivalry after the military junta, dominated by the Army and Navy, seized power in 1955. It abandoned many of the Air Force's fighter projects to concentrate on transport and smaller aircraft. The Air Force requirements for fighters would be fulfilled through purchases abroad. During the period 1955-78, the most important aircraft designed and produced were the IA-50 Guarani II light (early 1960s), twin-engine transport and the IA-58 Pucara counterinsurgency plane [Ref. 4].

[271]An interesting point that is not covered in the literature is the destiny of the Rolls Royce engine production, mainly after the Malvinas war. One source shows that the last production of Rolls Royce engines was in 1953. After that, Argentina produced turboprop engines under a license from Turboméca (France) in 1974 [Ref. 6:p. 43].

[272]FAMA bought five computer-controlled milling machines from FR Germany and composite material technology has been introduced for use in the engine intakes and wing tips. Also a large U.S. computer has been bought to manage the production of the IA-63 and future aircraft [Ref. 6:p. 42].

indigenous production to licensed production dependence. Today, the aircraft industry seems to suffer from the many changes during its development.

The aeronautical cooperation agreement between Brazil and Argentina is seen as a way that both industries can survive economically. Not only this agreement but other agreements in different sectors are facilitating the trade of commercial and military products[273]. These cooperation agreements have also provided an environment favorable for future mutual transfer of technology between the countries.

The Argentine aircraft industry background and tradition may be combined with the recent Brazilian aircraft industry technology development for the joint production of various new aircraft. The author estimates that this variable may be graded as having medium impact due to the equilibrium that is obtained between the FAMA historical background and the present EMBRAER technology.

Q3) What are the recipient firm's characteristics?

Although EMBRAER in this agreement seems to be more of a supplier than a recipient company, it is analyzed under this heading because the impact of the offset agreement in a Brazilian company is the ultimate objective. After 20 years since its first project Bandeirante, EMBRAER today has significant experience in the design and production of turboprop planes. According to EMBRAER, the CBA-

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[273]The Argentine Air Force sought a contract for 40 EMB-312 Tucanos to integrate into its fleet. The contract asked for manufacturing parts in addition to the assembly of the kits. This acquisition was to provide an interim replacement for the old Mentor and Paris aircraft prior to full-scale production of the indigenous FAMA IA-63 Pampa. The cost and the poor delivery schedule were the main reasons for the rejection of the EMBRAER option [Ref. 21].

123 will be a substitute for the Bandeirante. Therefore, many changes are not expected inside the EMBRAER production plant for this manufacturing project, since the same Bandeirante production installations will be used for the new aircraft [Ref. 11]. The project also has great commonality with the EMB-120 Brasilia, and new technology innovation will not be necessary[274].

Considering the technological level and evolution of EMBRAER turboprop aircraft, as seen in the EMB-110 Bandeirante, the EMB-120 Brasilia, and now the EMB-123 Paraná, and its significative share in this agreement, the company characteristics variable is evaluated as high.

Q4) What are the suppliers firm's characteristics?

Although FAMA in this agreement is not really a supplier, it is evaluated for the same reasons EMBRAER was evaluated as a recipient. Argentina's defense sector[275], specifically FAMA is well known as being under the strict tutelage of the military. However the government has observed the successful Brazilian model and began a "five year" privatization plan of this sector[276]. Sharing the same economic problems as Brazil, such as inflation, high-debt, and unemployment, the Argentine aircraft industry also has been severely tested by constant policy changes. In terms of aeronautics research and development capability, the company has been not

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[274]See "The EMB-120/123 equation" [Ref. 12] for more information about these two related projects.

[275]See a description of the Argentine arms industry in Milenky [Ref. 4] and Porth [Ref. 2].

[276]The "five-year" plan means a gradual shift from a military controlled organization to a private enterprise [Ref. 2:p. 66].

well supported because of government priority given to space and nuclear technology research. The Institute of Aeronautical and Space Research (**Instituto de Investigatione Aeronautica y Espacial**) has conducted its efforts more in space, rockets and electronics technology than in aircraft development[277]. FAMA is comprised of two large divisions. The **Instituto de Investigationes Aeronauticas y Espaciais (IIAE)** is responsible for the design, manufacture and testing of rockets, sounding equipment, and the aircraft manufacturing facilities (**Grupo Fabricacion**) situated in Cordoba. FAMA also controls the **Centro de Ensayos en Vuelo** (Flight Test Center) to which all aircraft produced in Argentina are sent for certification tests. The laboratories, factories and other aeronautical division buildings occupy a total covered area of 253,000 square meters. By 1980, the **Area de Material Cordoba** employed more than 5,300 people of whom 2,300 are in the Grupo Fabricacion [Ref. 6:p. 40].

Although the Argentine aircraft industry started producing aircraft before Brazil, today FAMA has a technological level below that of EMBRAER[278]. The coproduction of a civilian plane together with Brazil will provide FAMA production and marketing expertise needed by the company to start competing internationally. Factors pointing to a low value on this variable include FAMA's actual technological level being below EMBRAER, the company's political instability, and the lack of R

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[277]The lack of Air Force aircraft projects is very curious considering the Air Force power and influence after the Malvinas war because of its bravery and inventiveness in combat [Ref. 2:p. 57].

[278]FAMA has worked on 56 aircraft types since its creation in 1927 of which 24 (including civilian types) have entered production [Ref. 6:p. 40].

& D applied to the aircraft industry. These may be balanced by the traditional success in some indigenous projects in the past and the expected changes that would be provided by the "five-year" plan towards privatization. FAMA is graded as medium.

Q5) Will this technology be integrated?

The Argentineans have been successful in aircraft overhaul work and also with reverse engineering, eliminating expensive R & D and production costs and cutting down on lead time [Ref. 2:p. 67]. But, as in Brazil, the industry is still hampered by the fact that many of the parts needed to produce completed systems must be imported (e.g., engines).

Both FAMA and EMBRAER are endowed with production and assembly experience. EMBRAER seems to have more expertise in design and composite materials technology. What seems be happening in this case is a complementary division of labor between the two companies in which each one will produce components in which they have more experience and technological background. Assuming that both companies will add a small amount of new technology to their existing capacity, and the evidence that they have shown a high absorption capacity in previous transfers of technology, this variable rests between these two extremes. The technology from the new aircraft appearss to have a medium integration value in both companies.

Q6) Does this offset agreement conserve foreign exchange?

One of the main reasons for the economic alliance between these two countries is the possibility of hard currency savings. This aircraft, being produced

in the same region, will bring similar benefits as the European countries have experienced with their common market. Neither Brazil nor Argentina will need to expend "dollars" in the acquisition of foreign made aircraft in a developed country market, where they may find a lot of financial obstacles with international banks because of their foreign debt. The new commercial cooperation between two developing countries may be a potential source of large offset agreements, including not only aircraft but a great variety of products[279].

Because this agreement represents a great incentive for potential generation of offsets through coproduction agreements, which improve the countries' capacities to save hard currency, the foreign currency savings variable is considered to have high impact.

Q7) Does this agreement create jobs?

The Argentine government "five-year" plan in which FAMA intends to replace the military personnel by civilian personnel, is by itself, a great initiative for creating new jobs in that country. To develop its aircraft industry, the presence of skilled and trained personnel is crucial. Today, the constant turnover of military personnel (normally two years) has been contributing to discontinuity in the work plans. Also the fact that most of these military officers are taking these decision-making positions at the ends of their careers and are relatively inexperienced in particular plant problems may not be the best solution for the industry. As a result,

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[279]This commercial tendency has been observed in other industry sectors such as automotive. The new conglomerate called Autolatina is formed by Volkswagen from West Germany and Ford from the U.S., which combines their Brazilian and Argentinean plants to improve the exchange of mechanical assembly and components, and consequently allowing higher production volumes [Ref. 22].

the arms industry in Argentina has been losing many of its civil engineers and scientists in a classic brain drain [Ref. 2:p. 67]. It is evident that this agreement for Argentine would provide FAMA more motivation for profits and efficiency, which would provide the incentive for the definitive implementation of the "five-year" plan.

In the case of EMBRAER, the situation appears to be different. This agreement will absorb the work force of the Bandeirante production line, so there will be little real job creation. In terms of employment, the importance of this new project is the support of existing workforce [Ref. 12].

Because of the partial impact expected with the real jobs benefits for Argentina and the maintenance of employment capacity in EMBRAER, this variable is rated as having medium impact.

Q8) Does this offset improve exports?

Although the general export objectives of Argentina's defense industries are different from the Brazilian defense industries, Argentina's wish to develop a viable arms industry is increasing its attention towards the international market. As in Brazil, Argentina found that their own military services cannot absorb the production and they must resort to export markets. One example illustrating this change was the recent sale of six Pucara aircraft to Uruguay. The production aircraft reportedly cost $3 million each and were sold for only $1.8 million. As a result, other countries became interested in the same aircraft in a highly competitive market. The Argentineans' success in arms export has been limited to

South American countries[280]. The industry is striving to build better products at lower cost to gain a solid export market for its equipment, but it faces some problems in meeting its export goals. Assembly lines are not always able to meet export requirements which can cause delays in delivery schedules. Another Argentine defense industry deficiency is the overall marketing plan. Some people may explaining this by saying "military people don't make good marketing people" [Ref. 2]. Another problem is that the final price is also driven up by short production runs. This could encourage buyers to find other better-established export possibilities and lower prices in another countries.

The CBA-123 is being designed and developed to cover a gap in the market. A common 19-seat aircraft occupies 36% of the regional airline international market now and will continue to hold 30% up to the year 2005. There is also a useful fill-in market for a corporate version for eight to 12 passengers [Ref. 23]. The EMBRAER commercial director Serra said that the specific marketing strategy for this aircraft forecasts 10 year sales of 400-500 aircraft with the possibility of reaching 600 airplanes. The break-even point will be reached with the sale of the 400th airplane. The corporate market for this aircraft will be 25%. The U.S. represents 50-60% of the estimated CBA-123 market, Europe 15-20%, South America 15%, with Australia and Southeast Asia the remainder [Ref. 24]. The marketing will be executed jointly by both Brazil and Argentine, although each country will have exclusive sale territories [Ref. 10]. EMBRAER and FAMA plan to

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[280]The IA-58 Pucará aircraft has been sold to Uruguay (8), Venezuela (24), and El Salvador (unknown) [Ref. 6:p. 49].

deliver 15 aircraft in 1991, and 26-28 in 1992. The production schedule calls for a five per month rate by 1993. At that time, the planned production split will be 3.5 aircraft per month by EMBRAER and 1.5 by FAMA [Ref. 10]. The CBA-123 is not a low-priced aircraft and EMBRAER is making special efforts to ensure that its operating costs will offset its initial cost [Ref. 23].

The lack of FAMA marketing expertise will be complemented by EMBRAER's experience and commercial network to implement aggressive sales worldwide. The division of the world market in two proportioned shares will give EMBRAER certain advantages in sales in relation to FAMA. The success of EMBRAER exports is evidence that its market planning has been accurate and well developed. Based on the expected success of EMBRAER exports, even in developed countries markets, this variable is graded as having high impact in the CBA-123 case.

Q9) Does this agreement obtain financial investment?

As in Brazil, Argentina's lack of funds to finance aircraft projects is the bottleneck for more development in civilian programs. However, in the military programs the situation is somewhat different. Although after the Malvinas war the Argentine armed forces budget was cut, important projects such as the IA-63 Pampa advanced trainer seem to have sufficient momentum and commitment to continue regardless of economic conditions[281] [Ref. 2:p. 59]. The same lack of

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[281]This aircraft is being produced in conjunction with the West Germany company Dornier. The Argentina Air Force has a requirement of 250 of these jet trainers [Ref. 6:p. 42]. For more information about this project see "Argentina's IA-63 stepping stone to 1990s technology" [Ref. 25].

funds to develop new civilian projects is present in Brazil, and funds directed to projects such as the AMX seem to be the government priority. Because the CBA-123 is more for civilian application than military, it follows different government rules. The Brazilian government now invests solely in military programs, leaving civil ventures to be financed by commercial loans and the sale of equities. The other successful way of getting financing for this project is through options [Ref. 23]. According to reports, this plane has already received 127 options for its purchase [Ref. 26].

Although it seems that one of the main reasons why EMBRAER invited FAMA to engage in this agreement was to partially finance the project, EMBRAER president Ozilio Silva said that the company "could find money almost anywhere", which means that this was not the main reason for the agreement. He said that the market potential was the main reason that drove the agreement [Ref. 12].

The specific capacity of the CBA-123 to generate funds to partially cover the estimated $300 million ($200 million for EMBRAER and $100 million for FAMA) is considered high, even with these companies financing their shares by themselves without governmental financial participation.

Q10) What are the internal and external political motivations for this agreement?

The external and internal political motivation for this agreement is one of the most important variables influencing this agreement. Offset agreements between these two nations have been motivated by strong political forces inside these two countries. Both nations are crossing the political transition from a military

rule to a democracy[282]. They are suffering a similarly dramatic economic crisis, and are trying to negotiate for better terms to pay back international loans. Finally, both countries are experiencing similar social problems. Due to their common problems, they both decided to join forces to establish democracy and political stability, to negotiate with international banks, and to improve the social conditions of their people[283] [Ref. 429].

The small scale of the CBA-123 case is useful to show characteristics of the political motivations in defense industries projects of both countries. Against all expectations, the civilian presidents that are seizing power in these countries are continuing to provide incentives to the defense industries, because of their importance as a generator of jobs, as an increasingly important participant on the balance of trade, and as a tool for foreign policy. The military will continue to administer the defense industry, particularly the aircraft industries, though they have lost to the Congress some of the budget power to finance projects[284].

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[282]Argentina elected a civilian president in 1983, and Brazil is electing directly its first president in November 1989, both after a long period of military rule.

[283]The most important event in politics in the Southern Cone of South America in the past several years was the visit to Argentina by Brazilian President Figueiredo in May 1980. Coming at the end of a turbulent decade in Brazilian-Argentine relations characterized by intense and often shrill verbal warfare, keen politico-economic competition in adjacent countries and atomic rivalry with ill-concealed military overtones, Figueiredo's trip possessed unusual significance. At that time it was proclaimed that the two governments were abandoning "competitive schemes" in order to forge "a zone of peace and security that embraces an entire fringe of the South Atlantic" [Ref. 5].

[284]Much focus in this transition of political power rests on the control of the arms industry. The military still retain power over the defense industry. The new governments' options to leave the military with the industries is one way to keep them concerned with defense matters instead of politics.

Brazil and Argentine both have great need to cooperate politically, because they have the same motivations. The political motivation variable in this case is considered as of high impact in the socio-political factor.

Q11) How does this government act in this offset?

Both governments have similar interests in any commercial agreements. Besides economic gains, they represent the exchange of technology, jobs, exports, and political influence. The Argentine government is the primary actor in this agreement. As a negotiator, the only previous experience of FAMA in dealing with coproduction and licenses came from the 1970s Europa Plan where the effort was to find European defense firms and generated German assistance. After that only small agreements, including some transfers of technology, have been signed with Germany's companies. The Argentine government was more directly involved in this agreement because FAMA is one the defense industries still under a military rule. The Brazilian government has been active in most of the coproduction agreements and its last experience was the negotiation with the Italians for the AMX aircraft program. However, in this agreement, the Brazilian government shifted the responsibility of negotiation to EMBRAER, which shows the maturity of the company in conducting international negotiations.

The governments' capital participation in this program seem to be restricted to the purchase of 36 aircraft units each which will improve the minimum number of options to launch the project into production. The Brazilian government action in this agreement is considered more political than as a capital investor such as using GFE, machines, tools, etc. These two extremes of government

level of interference provide the basis to assign a medium level of influence of the governments in this case.

Q12) What are the political and social pressures of this agreement?

The similarities in the political and social evolution in these two countries have caused a polemic discussion about the role of the military in remaining in control of their defense industry. Although the process of these socio-political changes seems identical, the governments have been applying different problems toward their aircraft companies.

In Argentina, aircraft production has been insulated from politics. In its earlier years there were some political leaders such as President Juan Péron that particularly supported the aviation industry. At that time, some political conflicts ensued as military officers were interested in creating an extension of their job opportunities after retirement, instead of genuine patriotic motives. Today, the defense industries are not affected by the politics simply because it is managed by professional military heads who are on active duty. Before assuming these positions they are trained in management and decision-making functions which help to improve their skills to handle long-term projects. But this could change suddenly as the government "privatization" takes effect [Ref. 2:p. 59].

In Brazil, the tendency towards privatization has been smooth and more effective. Little by little, EMBRAER has been gaining experience as a multinational company, and the government support has been restricted only to financing military programs.

Both countries participating in this coproduction agreement are experiencing dramatic changes in their socio-political environment. Some evidence of these changes are the new Congressional "power of the purse" and the labor unions legal right to strike in Brazil. It is obvious that all levels of the Brazilian and Argentinean society will participate more in any international agreement which will involve large amounts of public funds. This variable is graded as medium because of the difference between the political and social pressures between these two countries in their aircraft industries.

Q13) What are the benefits of this agreement for industrial defense?

Brazil and Argentina are among the leading third world arms producers. The constant embargoes by developed countries in the delivery of weapons developed the ambition in these countries to be independent from arms suppliers. The military, supported by the political power that gave them the government direction during long periods, found the opportunity to implement the infrastructure for a large industrial defense base. Today, the political situation of these countries is changing and the military is transferring the power back to elected civilian presidents. Contrary to expectations, the arms industry complexes still remain under the military rule. Most of these industries are state-owned and very dependent on government funds and orders. The future of these industries is unknown but each government is trying to find solutions for their continuity regardless of their economic situations.

The CBA-123 case is an example of one of the solutions found by both governments to make a project viable and to continue to support a competitive level of employment, investment, and technology. In this case, because the governments are in a difficult financial situation, the responsibilities of funding the project were shifted to their industries, which increases the risk of the projects. One way that these industries found to decrease this risk was through the development of a basic civilian aircraft design with the possibility of deriving military versions. The government contribution in this sense is in being flexible regarding technical requirements. The strategy was successful in previous projects, like the Bandeirante aircraft, and probably will be again.

The benefit of developing new projects within these economic limitations shows how developing countries defense industries survive in the international market. The enforced government position to shift heavy responsibilities to their industries and their capacity to overcome these barriers through cooperation agreements such as this is enough to sustain a high grade in this variable.

Q14) Does this agreement bring international prestige?

The commercial cooperation between Brazil and Argentina has been recognized by the other Latin American countries as an important step for the development of a "Latin America common market". The CBA-123 aircraft certainly will be sold in various Latin American countries because of the numerous facilities that would be provided to the operators, since financial arrangements (or offsets) are available to maintain these facilities. The aircraft will be considered a symbol

of the technological level of these two countries and certainly will bring high prestige.

Q15) How does the technology embodied in this offset improve the national military capability?

Both Argentina and Brazil have shrunk their military budget to the minimum necessary to maintain operations and revitalize old equipment. The Argentine government cut its military budget after the Malvinas war. However, one of the primary goals has been to revamp the military organizational structure and rebuild its inventory through foreign acquisition as well as local production. Brazil has engaged in a recent plan of modernization where some second-hand fighters from France and U.S. were bought just to replace losses. Both countries are trying to maintain the military balance of their forces.

The CBA-123 aircraft military application will be very similar to the actual light transport aircraft existing in both air forces. This plane is designed to replace the EMB-110 Bandeirante series in its variety of missions such as troop transport, maritime patrol, and cargo aircraft in the Brazilian Air Force; and the IA-50 Guarani II in photo reconnaissance, navigation aid calibration, and light transport roles in the Argentine Air Force [Ref. 28:p. 20].

Because of the weak military budget of these two countries and the necessity to reequip the light transport aircraft in a relative short time, the CBA-123 may be considered as of medium contribution for Brazil and Argentina military capability.

Q16) How does this agreement contribute to the country's independence and non-vulnerability?

Another common factor between Brazil and Argentina is the idea of dependence and vulnerability. Both countries have been motivated to develop indigenous arms production to prevent developed nations arms embargoes[285]. The military governments in these nations have promoted an expansion of local weapons industries that has served to improve civilian industrial development and to guarantee the armed forces some security of supply of basic items such as light aircraft.

In Argentina, the foreign-affairs community has developed two general approaches: the classic liberal and the statist nationalist schools. There is substantial disagreement between these two groups in questions related to arms production. The nationalists, particularly in the armed forces, have supported indigenous arms production and basic industry as directly relevant elements in the creation and maintenance of national power and independence. In general, this approach is supported by the majority of intellectuals, urban professionals, union leaders, and members of the Perónist and Radical political parties. The liberals are inclined more toward negotiating for technology transfer and arms in the context of a long-term drive for independence in which the private sector has the primary role. Today, Argentine arms production seems to follow a liberal approach, where

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[285]The case of Argentina has been more serious because of recent wars. During the "dirty war" (the military government against the guerrillas), President Carter's administration embargoes arms export to Argentina because of human rights. In 1982, During Malvinas war, U.S and West European supplies were cut [Ref. 2:p. 61].

the classical liberals would negotiate international economic relationships to improve prospects for foreign-exchange earning and would seek to import foreign weapons systems and technology where cost advantages outweigh domestic production [Ref. 3]. Specifically in the case of the CBA-123, Argentina is applying the liberal approach although the advantages are more commercial than technical.

The negotiation of coproduction agreements between two third world countries for the production of turboprop aircraft may be the beginning of a new era for these nations. The division of labor between Brazil and Argentina is an important strategy towards a market expansion, which consequently would improve the leverage to negotiate better technology transfer terms with developed countries.

In summary, because both countries have experienced constant embargoes in arms transfers, they have decided to be independent in arms production. The level of contribution of this agreement for lessening dependence and vulnerability in relation to developed countries is considered medium, due the low level of technology exchanged in balance with the facilitating access of transfers created by these countries because of their geographical situation.

OFFSET OUTCOME

The results of the analysis of this agreement shows interesting findings from a case in which the transfer of technology is between two developing countries. Because of the similarities of economico-political problems, Brazil and Argentina became allies through various commercial cooperation agreements. The economic aspects of this agreement are in obtaining finance, improving exports,

and providing some foreign exchange savings. The political aspects of this agreement are to improve the defense industries, consolidate the democratic regimes, and create the perception in Latin American countries of the leading role these two countries play in the continent. Table 27 shows the general results of the CBA-123 case.

Q18) Does this agreement provide independent technological capabilities?

The transfer of technology between two third world countries is a recent phenomenon which requires additional study in order to better understand the impact of this process in these nations' development.

The CBA-123 may be a limited case which shows the dimension of these transfers, because it involves two countries that historically have competed for leadership of the South American continent, and it includes a low portion of technology transfer. The difficulty in the exchange of high technology between these two nations is yet to be demonstrated due to their political instability. However, as these countries become more structured politically and economically, the cooperation and offset agreement environment will improve and technology certainly will flow normally.

The independent variables analyzed under this outcome show that better results may be obtained when the transfer environment between two countries accommodate more equitable worksharings. Another observation is when there is a difference between recipients and suppliers in coproduction agreements, the type of technology transferred is not so significant.

Although it would be more interesting if the case would have involved a fighter aircraft instead of a turboprop, this case allowed some superficial conclusions about the medium level of technology exchanged between Argentina and Brazil in its major technological agreement. Table 24 shows the independent technological outcome results.

Table 24

CASE: CBA-123	
VARIABLES	GRADE
Q17) OFFSET TYPE	COPRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	HIGH
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	MEDIUM
OUTCOME	
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM

Q19) Does this offset improve Brazilian national security?

Both countries involved in this coproduction agreement are motivated by similar approaches of national security which involves economic development and the military defense. For a long time, the Brazil - Argentina rivalry did not allow any attempt at cooperation. Today, they recognize that they have a "common enemy", underdevelopment, and they decided to join forces to become less vulnerable, with enough power and courage to fight against this situation.

The CBA-123 coproduction agreement is evidence that flexibility and innovation should be used wisely against not only the economic anomalies like external debt, inflation, and unemployment but also to solidify political and social positions. The case is one of the first steps toward major economic and political understanding between the two countries. The case also shows the offset potential if an agreement is negotiated adequately.

The socio-political and military independent variables analyzed in this case point to important conclusions. The internal and external democratic political motives are beginning to motivate different kinds of commercial cooperation agreements that are not possible under military regimes. The defense industrial base is a very important factor in making the agreements financially and technologically viable. Finally, the cooperation between two third world countries is creating a psychological perception of prestige even on the part of developed countries. Because these variables are very important in the outcome of this case, the final grade attributed to this outcome variable is high. Table 25 shows the national security outcome results.

Table 25

CASE: CBA-123	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVES	HIGH
Q11) GOVERNMENT ACTION	MEDIUM
Q12) POLITICAL AND SOCIAL PRESSURES	MEDIUM
Q13) INDUSTRIAL DEFENSE	HIGH
Q14) INTERNATIONAL PRESTIGIOUS	HIGH
Q15) MILITARY CAPABILITY	MEDIUM
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM

OUTCOME

Q19) ENHANCEMENT NATIONAL SECURITY	HIGH

Q20) Does this offset improve Brazilian economic capability?

Brazil and Argentina have similarities in having their armed forces as a significant factor in the political and economic processes of the countries. Even with dramatic economical problems the arms industry grew, closely associated with industrial cycles of these nations. They have been applying the same import-substitution models and hoping that national arms industries would create spin-off effects for other industries.

The CBA-123 case shows on a small scale the potential of third world countries to operate using offset arrangements and the additional economic benefits that this type of agreement may provide in dealing with developed countries.

The independent variables demonstrate that agreements like this offer a relatively high savings of foreign currency, export expansion, and capacity to finance projects. The savings of hard currency may be an indication of the benefits of these arrangements for countries which have a high debt level. The cooperation agreements may cancel the import barriers or activate existing networks, and provide great benefits in incrementing export levels and market shares. Finally, the financial capability may be multiplied with the share of funds appropriations. Besides these benefits, varying case-by-case, these coproduction agreements may support the workforce or generate new jobs. As an average, the economic capability outcome for the CBA-123 coproduction agreement is high. Table 26 shows the economic benefits outcome variables.

Table 26

CASE: CBA-123	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	HIGH
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	HIGH
Q9) ENHANCE FINANCIAL VIABILITY	HIGH
OUTCOME	
Q20) ECONOMIC BENEFITS	HIGH

Table 27

CASE: CBA-123	
VARIABLES	GRADE
Q17) OFFSET TYPE	COPRODUCTION
Q1) TYPE OF TECHNOLOGY	MEDIUM
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	HIGH
Q4) SUPPLIER'S CHARACTERISTICS	MEDIUM
Q5) TECHNOLOGY INTEGRATION	MEDIUM
Q6) FOREIGN EXCHANGE SAVINGS	HIGH
Q7) JOBS CREATION	MEDIUM
Q8) EXPORT EXPANSION	HIGH
Q9) ENHANCE FINANCIAL VIABILITY	HIGH
Q10) INT/EXT POLITICAL MOTIVATION	HIGH
Q11) GOVERNMENT ACTION	MEDIUM
Q12) POLITICAL AND SOCIAL PRESSURES	MEDIUM
Q13) INDUSTRIAL DEFENSE	HIGH
Q14) INTERNATIONAL PRESTIGE	HIGH
Q15) MILITARY CAPABILITY	MEDIUM
Q16) INDEPENDENCE/NON-VULNERABILITY	MEDIUM

OUTCOME VARIABLES	GRADE
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	MEDIUM
Q19) ENAHNCEMENT NATIONAL SECURITY	HIGH
Q20) ECONOMIC BENEFITS	HIGH

2. The AMX Fighter Aircraft Case

The AMX fighter aircraft case is an example of a coproduction type of offset agreement between the Brazilian and Italian governments which includes other aerospace companies within both countries. The project attempts the production of a high technology fighter aircraft and it is making major changes in the evolution in both the Brazilian Air Force and the aircraft industry. The basic information for this case was collected from various specialized aeronautics periodicals and personal correspondence with EMBRAER[286].

Q17) What are the offset agreement characteristics?

AMX is the Italo-Brazilian dedicated attack aircraft which resulted from a codevelopment and coproduction agreement between the Aeronautica Militare Italiana (AMI) and the Ministério da Aeronáutica (MAER) who have as partner companies Aeritalia Società Aérospaziale Italiana p.A. (Aeritalia) and Aeronautica Macchi Spa (Aermacchi) from Italy, and EMBRAER from Brazil[287]. The AMX aircraft is a product of many years of research and study, and it is the first multinational modern military fighter development program involving Brazil. The aircraft is capable of operating at high subsonic speed (0.86 mach), very low altitude, by day or night. It is expected to provide some improvement for all weather operations, and if necessary, it operates from bases with poorly equipped or partially damaged runways. Its primary missions are to perform ground attack, low level armed

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[286]The author of this thesis worked in the AMX program for 3 years. Due to security reasons of both countries involved, neither personal experience nor confidential information acquired during this assignment is used in this thesis.

[287]The agreement was signed in march 27, 1980 [Ref. 1].

reconnaissance, as well as anti-ship attack and coastal patrol missions[288]. Work on the two-seat version, with improved combat capability, began in mid-1986 and it will have additional capabilities such as operational conversion and advanced training[289]. The aircraft has a weapon load capacity of 8,500 lb (3800 kg), is powered by a Rolls Royce Spey RB 168-807 turbofan engine, and has a highly integrated ECM (Eletronic Counter Measure) self-protection system together with excellent self-defence capabilities [Ref. 2].

The bi-national agreement requirements call for a total of 317 aircraft, 238 (187 single-seat and 51 two-seats) for Italy and 79 for Brazil (65 single-seat and 14 two-seat)[290] [Ref. 3:p. 111]. The respective companies share of design, development, and production of the aircraft is Aeritalia (46.7%), EMBRAER (29.7%), and Aermacchi (23.6%). Each country has a separate assembly line. Each of the countries is also responsible for the assembly's performance, execution, and financial burden as divided along the management lines [Ref. 5:p. 83]. The Rolls-Royce engine is built under license by Fiat Aviazione (major contract) and CELMA (22% of total man hours required). The engine is a two shaft turbofan of modular

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[288]The prime features of the AMX are readiness, low vulnerability, high survivability and safety, and in-flight refueling [Ref. 2].

[289]EMBRAER is undertaking design of the dual controls, canopy, and integration of the Ferranti rear cockpit HUD (Head-up display) monitor; and redesign of the environmental control and oxygen systems [Ref. 3:p. 11].

[290]The joint program has a basic aircraft but each country has its own version with different equipment and weapons (e.g., the Italian AMX has a single GE Vulcan 20 mm six barrel Gatling gun, while the Brazilian version has a twin DEFA 30 mm cannon to give more punch against air-to-ground targets. Also, the Brazilian version requires VOR/ILS whereas the AMI uses TACAN) [Ref. 4].

design and CELMA will produce twelve components, including the compressor entry, guide vanes, the compressor casing, the intermediate casing, the casing of the accessory gearbox and various parts of the ducting [Ref. 6].

The total investment of the Brazilian share of the AMX (30%) was estimated at $600 million, but recent estimates show that the Brazilian government investment will be about $2.85 billion, including the 79 aircraft. The reason for this difference is the capacity required for industry and the numerous changes made by the Brazilian Air Force in the initial project [Ref. 7]. The program is divided basically into two major phases; the development phase, initiated in January 1981, and the production phase, initiated in the late spring of 1987 [Ref. 3:p. 111]. During the development phase, seven prototypes were built (three by Aeritalia, two each by Aermacchi and EMBRAER), plus one airframe (by Aeritalia) for static testing. In addition, selected components for fatigue testing were completed by each of the three companies[291]. The production phase is expected to continue until 1994 when both countries air force requirements should be met (See Table 28). The AMX program financial arrangements and "end-user" clause are unknown[292].

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[291]The first EMBRAER prototype (A-04) flew on 16 October 1985 and the final one (A-06) made its initial flight on 16 December 1986 [Ref. 3:p. 111].

[292]One source concludes there will be export restrictions due to the engine origin. For instance, the Rolls Royce engine may restrict the sales of the aircraft to Argentina [Ref. 8:p. 10]. Other sale restrictions to the Arab world may result from the Israeli Elta radar [Ref. 9].

TABLE 28

AMX ESTIMATED DELIVERIES

Y E A R	A M I	F A B	T O T A L
1988	6		6
1989	33	11	44
1990	41	16	57
1991	39	16	55
1992	39	16	55
1993	29	16	45
1994		4	4
TOTAL	187	79	266

Source: "Está Chegando a Hora" Segurança e Defesa, no.20, p.8, 1988[293].

Deliveries were expected to begin to the Italian Air Force in June 1988 and the Brazilian Air Force in May 1989[294]. The organization of the program is shown on Table 29.

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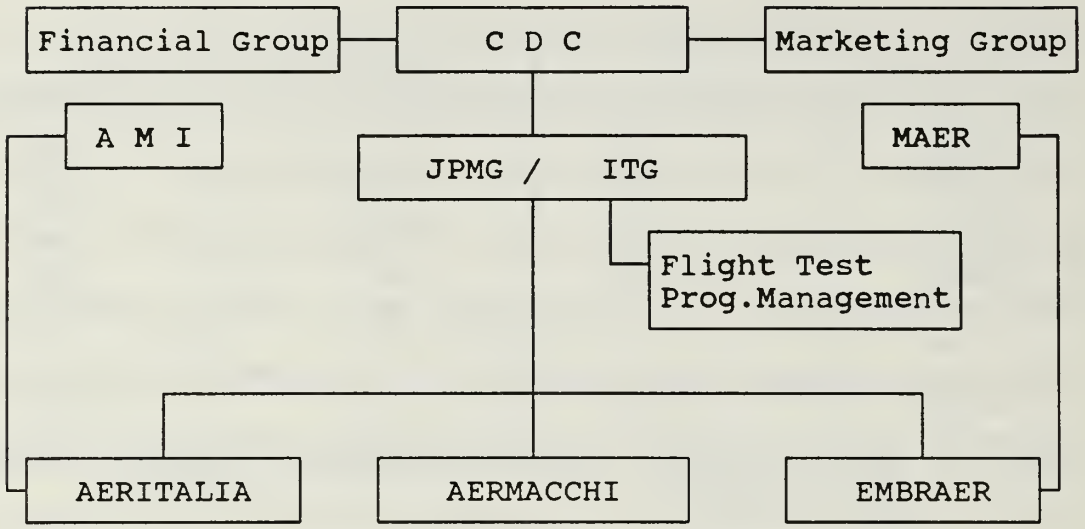
[293]The Table 28 figures do not include the 51 two-seats for the AMI, and considers the FAB 14 two-seats aircraft included in the 79 total Brazilian requirement.

[294]The program schedule was delayed at least one year. The Italian Air Force received its first AMX in July 1989 and FAB will receive the first aircraft one year later [Ref. 4].

TABLE 29

AMX PROGRAM ORGANIZATION



CDC: Comitato Diretivo Congiunto
JPMG: Joint Program Management Group
ITG: Integrated Technical Group

Source: Brian Wanstall, "Production-line AMX", Interavia, June 1989, p.582.

Q1) What type of technology is being transferred?

The AMX fighter is the most advanced military fighter in which a South American country has had a production share, and a large amount of technology transfer is expected to occur under this program [Ref. 10]. The worksharing was carefully divided among the contractors. Aeritalia is responsible for the fuselage center-section, nose radome, fin and rudder, elevators, flaps, ailerons and spoilers. Aermacchi was given the forward fuselage, including gun and avionics integration, canopy and tailcone. Finally, EMBRAER is being involved in the air intakes, wings,

wing leading-edge slats, tailplane wing pylons, external fuel tanks and reconnaissance pallets.

The companies marketing this aircraft have emphasized the survivability as the main characteristic of the aircraft. The AMX has triple wing spars and duplicate fly-by-wire flight control systems. The prototypes have been tested in "get home" mode successfully, simulating both electrical and hydraulic failure [Ref. 4].

The specific terms of product design and production techniques transferred to EMBRAER are unknown, but the company has published in its annual reports the acquisition and expansion towards new developments in design (CAD-CAM - Computer-Aided Design, Computer-Aided Manufacturing), manufacturing (Numerically controlled milling machines), and composite material technology which are assumed to be related to the AMX program needs [Ref. 11 and 12]. The engine technology transferred to CELMA seems to be old, but the engine is considered robust, reliable, and very economical [Ref. 4]. A factor that improves the value of this engine technology for Brazil is the fact that this project is the first CELMA experience in manufacturing engine components and certainly represents a significant step in the developing of the engine industry in Brazil.

Considering the AMX as the most advanced subsonic fighter already coproduced in South America, and the impact that the AMX development and production is having on the EMBRAER and CELMA technology environment, this variable is graded as high.

Q2) What is the technology transfer environment?

The technological environment for this agreement is very complex because it includes many companies not only inside both countries but also outside them. Besides the main contractors in each country (e.g., EMBRAER), other subcontractors are developing and producing different components and parts as a sole source for the common version (e.g., Fiat FA 150 Argo APUs - Auxiliary Power Unit for engine starting are common for both versions), or as dual-source for each country version (e.g., FIAR is producing radar just for the Italian aircraft). The contribution of this variable to the AMX technology transfer environment is analyzed on three dimensions; a "**mutual need**" environment, government-industry relationship, and the specific changes in the Brazilian companies required to accommodate the program requirements. Regarding "mutual need", both Italy and Brazil have been looking for a partner to share the program, since it was not possible to develop it alone. Sharing the work will help finance, keep the risk lower, increase the number of orders to spread the costs, and promote exchange of design technologies and know-how without spending funds on licenses fees and royalties. The Brazilian government had been paying attention to the AMX program since 1977, when the Italian companies began its development. Only three years later, in 1980, did the Italian government invite the Brazilian government to participate in the program[295][Ref. 13]. The division of labor gave each company a

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[295]One important detail that should be observed is the past relationship between EMBRAER and Aermacchi for the Xavante trainer production under license in the period of 1970 to 1982. This relationship seems to have helped the preliminary understandings between the companies which consequently might have contributed to influencing the Italian government toward the Brazilian option.

fair share, according to their technological capability. The entire program seems to be well integrated and balanced to obtain maximum mutual benefits.

The integration of government and industry objectives into a very complex program created conflicts of interest and behavior. Problems included different languages (the official language of the program documents is English), different concepts of quality control (the NATO specifications were a new barrier for Brazilians accustomed to U.S. patterns), and legislation in each country (both countries have different procedures of procurement and acquisition).

The third dimension is that most of the Brazilian industries which engaged in this program have been making specific changes to accommodate all the bi-national requirements. The dimension of these changes is demonstrated by the relatively large amount of funds invested in the acquisition of new equipment and tools, personnel training in production and material handling, and financial controls improvements to attend to joint programs requirements. These changes represent not only the transfer of technology but a huge exchange of managerial concepts and techniques.

In the AMX technology transfer environment three basic points were identified. The "mutual need" factor, and the significative changes provided in the AMX related Brazilian industries are the positive points. The complexity presented by the exchange of various types and levels of technology and program management seems a challenge to be overcome. Because of these "pros and cons" this variable is rated as medium.

Q3) What are the recipient firm's characteristics?

Because Brazil is a minor partner in this program, EMBRAER and other companies involved in the AMX program were considered recipients. The recipient companies under this agreement may be divided in four main groups, according to their production specialty: airframe, engine, avionics and communications, and armament. Most of the firms of each group have specific tasks to manufacture the different components and parts specified by the MAER[296]. For example, TECNASA, a Brazilian electronic company, is producing the SMA SCP-01 radar specifically for the Brazilian version, instead of the Grifetto that will be produced by the Italian FIAR. Another example is the Brazilian specification of the MAA-1 Piranha infra-red air-to-air missile instead of the AIM-9L Sidewinder[297][Ref. 3:p. 112].

The analysis of the impact of the AMX on recipient industries is very complex and requires information that is not available for public release. EMBRAER is the major contractor for the Brazilian government and is receiving considerable governmental funds to develop its part of the program. Other companies function as EMBRAER subcontractors or as contractors directly with the Brazilian government (e.g., CELMA is directly contracted by the government). The focus of this analysis rests on the major contractor. Evidence of EMBRAER's **technical**

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[296]The quantity of Italian companies subcontracted to supply components and parts for the basic version is infinitely bigger than the Brazilian companies. This demonstrates the technological gap between the two countries and a certain Italian "supplier power" in specifying domestic equipment for the basic version. The only alternative for the recipient government is to specify different major sets for its particular version, according to the technological level of its industrial base.

[297]The production of this missile is under a Brazilian government contract with ORBITA. This contract was seriously affected by the 1988 Brazilian government budget cuts [Ref. 14].

absorptive capacity of AMX technology is the delivery of the first production kit in August 1987 [Ref. 15]. The company's **potential in competitive markets** for this aircraft is unknown because no additional orders outside the participant countries has been made for this aircraft, although some countries have already expressed real interest in buying the product. Other challenges that EMBRAER has worked with are keeping the costs down to be more competitive in the international market, and maintaining the market share negotiated with the Italians.

The role of the recipient in the AMX case is a mixed picture. The EMBRAER subcontractors and other companies directly contracted by the Brazilian government have been participating marginally in relation to the Italian industries because of the worksharing negotiated, which was conditioned on the limited technological level of the Brazilian aircraft industry in general. Keeping the program costs down and expanding the market share will be difficult. This pessimistic picture is being offset by the government specifying domestic components to equip the Brazilian version and the EMBRAER success in meeting deadlines in the production of the aircraft sets. Due to this imbalance between negative and positive points, this variable is graded as medium.

Q4) What are the suppliers firm's characteristics?

The supplier's companies of this agreement are many and may be divided in the same four groups as in the recipient variable. Because EMBRAER is mainly an airframe manufacturer and most of the flow of technology that comes from Italy is being directed to that company, this analysis focuses on the airframe suppliers group.

The suppliers of the airframe technology are basically Aeritalia and Aermacchi. Aeritalia is a joint stock company formed on 12 November 1969 by an equal shareholding of Fiat and IRI - Finmeccanica to combine both companies aerospace activities. In 1976 IRI-Finmeccanica purchased stock owned by Fiat, thus acquiring complete control of the company's stock capital. Since 1981, the company has decided to invest by buying other companies' stocks[298]. The organization is based upon a centralized general management and seven operational groups. The combat aircraft group, located in Turin, is responsible for working on the AMX combat aircraft and other combat aircraft as well[299]. The combined Aeritalia workforce is approximately 14,500 [Ref. 3:p. 142]. Aermacchi is the aircraft manufacturing company of the Aeronautica Macchi group. Its plants in Venegond airfield occupy a total covered area of 33,000 sq mt. The company actually produces the two seat trainers MB-339A, manufactures the wings for the Aeritalia G-222 and underwing pylons for the Panavia Tornado. The company is also active in the field of aerospace ground equipment (AGE), with a complete line of hydraulic, electric and pneumatic ground carts for servicing civil and military aircraft. Total workforce at the beginning of 1988 was approximately 2,500.

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[298]In 1983, it bought 25% of Aermacchi. In 1988, it acquired a certain percentage share in FAMA (Argentina) [Ref. 3:p. 142].

[299]Besides the AMX, the Turin group is responsible for outer (movable) wings, final assembly and flight testing of the Panavia Tornado; definition, design and development of the Eurofighter; space vehicles; carbonfibre ailerons and rudders for the Boeing 767; and an improved weapons system for the F-104. Other activities include extensive research in various fields of aerodynamics and advanced technologies, and repair, overhaul and maintenance of aircraft [Ref. 3:p. 142].

In summary, the suppliers in the AMX agreement are divided similar to the recipients, which enhances technology flow not only to EMBRAER but also directly to other Brazilian components producers. The participation of these Italian companies in various international and NATO agreements is proof of their high technological capacity in receiving and transferring technology. The Xavante experience and the actual level of cooperation among the governments and companies assured that the transfer of technology between these two countries is effective. The above analysis of the airframe suppliers produces a conclusion that the Italian companies are well prepared technologically to design and develop the AMX, and also reliable in the transfer of technology to Brazilian aircraft industry. This variable is graded as high.

Q5) Will this technology be integrated?

The integration of the technology provided by the AMX program was not evaluated in quantitative terms (e.g., percentage of domestic content), but some assumptions can be made based on the recent benefits obtained by EMBRAER due to the incorporation of new technologies. These benefits are basically from the technology spinoffs from other programs.

In early-1983, EMBRAER signed a cooperative agreement for transfer of composite materials technology with Sikorsky Aircraft Corporation. This has brought a lot of technology in this area [Ref. 16]. Although not directly motivated by the AMX aircraft, EMBRAER has been successful in the composite material technology integration. The company has applied this technology in numerous surfaces of its airplanes (e.g., Brasilia and Paraná) and in the production of parts

as a subcontractor (e.g., MD-11 flaps). A key piece of information is the company's intention to use these composite materials on the AMX, but there is no confirmed evidence of this utilization [Ref. 16].

The spinoffs benefits of the AMX technology to other programs such as Brasilia, Tucano, Paraná and others seems to be great [Ref. 17]. One example may be the improvement in the airframe design and airframe technology of the T-X design project, the new Brazilian advanced fighter to be totally designed by the company[300] [Ref. 19].

Because it was not possible to ascertain the integration of the AMX technology (based on time, skills and service sector factors) or any evidence of spinoffs in other programs, this variable is graded as medium, based just on the EMBRAER integration of other technologies.

Q6) Does this offset agreement conserve foreign exchange?

The data required to evaluate this variable completely is unavailable. What is the difference between the price to just buy 79 fighters and the total cost to produce them? Is this difference, obviously favoring the buy option, compensated for by the benefits obtained through the technology acquired in this agreement?

Since 1983, due to Brazil's foreign debt increasing (at that time $80 billion), the Brazilian government has been pushing to reduce imports by various measures. EMBRAER, trying to accomplish its development and the government

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[300]An examination of the feasibility of a codevelopment and coproduction agreement between the U.S and Brazil for a fighter was done by Reyners [Ref. 18].

policies, has placed more of its subcontracting work within the country. This initiative, though bringing a lot of benefits, has been only partially successful, since the majority of larger components for its aircraft are still imported from either the U.S. or Canada [Ref. 16].

If one looks at the impact of the AMX coproduction on the Brazilian balance of payments, the disadvantages of expenditures to equip the industry with machines, tooling, and raw materials does not seem to be compensated for in this program[301]. But programs in the future would use the same infrastructure to provide real savings.

Because of the heavy investment made by the MAER to enhance and equip the aircraft industry, the benefits of this investment would not be expected to be reached in this agreement, and this variable is graded as low.

Q7) Does this agreement create jobs?

Although it was difficult to ascertain precise data to analyze the AMX impact on employment some estimates can be made.

Despite the end of the Xavante production line in the early 1980s, the EMBRAER level of employment has continued to rise (see Table 15, Piper case). During 18 months (January 1982 to July 1983) the majority of those added were technical workers. The engineering department, including quality control, expanded from 800 to 2000. It was reported that the AMX program was demanding twice as

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[301]The first estimate for the break-even point of this aircraft was 250 units. According to the president of the commission that coordinates the project, Brigadier Ajax Barros de Melo, now it is necessary to sell between 500 and 600 units to break even [Ref. 17].

many hours for R & D and engineering, compared to the Brasilia program, showing some evidence of the improvement in employment quality and quantity because of the program [Ref. 16].

The employment impact of the AMX has also been large in other industries such as CELMA and other subcontractors.

A program with the dimensions of the AMX causes a great impact in the creation of specialized personnel in Brazil. Most of the employment benefits are obtained in qualitative and quantitative terms. This variable is graded as high.

Q8) Does this offset improve exports?

The future sales of the AM-X fighter in the international market is another difficult variable to estimate[302]. Although some countries have already demonstrated interest in the program, no order or option had been accepted[303]. Besides this, some potential customers such as Argentina and Arabian countries would not abide by "end-user" clause restrictions[304]. One evaluation of the future AMX market was found in a citation of the EMBRAER president Osiris Silva:

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[302]ACDA suggests the AMX and the new British Hawk 200 to serve as the "low end" of a relatively well equipped Third World air force, or the "high end" of one less well off [Ref. 20:p. 23]. British Aerospace figures as the main competitor for the AMX [Ref. 8].

[303]The Spanish CASA is offering some participation in offset terms [Ref. 4]. Saudi Arabia included the AMX in the military-industrial cooperation negotiated with the Brazilian government who has agreed to accept oil in payment [Ref. 21]. China was considering purchasing 500 AMX [Ref. 22]. Argentina was studying participation in the AMX program [Ref. 23].

[304]An interesting fact concerns the choice of the engine by the Italians. When Italy tried to sell its Aeritalia G-222 (with engine GET-64, General Electric) to Libya, the U.S government put restrictions for export because of the engine. This was one reason why the Italians has chosen Rolls-Royce engines for the AMX [Ref. 8:p. 10].

> Everybody has been attempting to build a new technology light attack aircraft that would replace the McDonnell Douglas A-4 for performance and cost. The AMX will do just that and be a better aircraft with new technology and not a trainer aircraft adopted for the attack role[305][Ref. 16].

These words predict a good prospective market for the AMX, although one of the clauses of the agreement preestablished a market share between Italy and Brazil that probably would restrict EMBRAER to expanding markets only in Latin America leaving Italy with a big share of Europe, Africa, and Asia [306][Ref. 24].

It is too early to forecast the AMX exports. It is even early to fix its price[307], but the aircraft may fit into a niche. One advantage of the commercialization of this aircraft is the series of options posed in various components to overcome the "end-user" restrictions. For example, the Saudi Arabian AMX may be offered with Tecnasa radar instead of one made by Fiar under license from Israel[308].

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[305]The intention of this citation was to compare the AMX with its main competitor. The British plane was designed for training and was adapted to combat, while the AMX was designed specifically for combat [Ref. 16].

[306]In 12 May 1984, Aeritalia announced that it plans to sell the AMX "to several Latin American countries" thus entering on a collision marketing course with EMBRAER [Ref. 24].

[307]The Brazilian AMX expected cost at the beginning of the program was $8 million. Today this figure has increased to $18 million [Ref. 17]. Most of the sources cite a $10 million (in 1983 values) price tag, which is the competitive price of this aircraft [Ref. 9]. A third estimate gives the flyaway cost as $13 million [Ref. 4]. According to EMBRAER officials, this will bring serious problems to marketing the aircraft (this price is 60% of the total cost of a supersonic F-16, close enough to direct the customer towards buying a more effective plane) [Ref. 17].

[308]The only exception to this rule is that the engine remains the same for both versions.

In summary, the positive aspects are the relatively good potential market of the aircraft, and the alternatives in including different components to overcome the "end-user" clause. The negative aspects are the market share constraints, estimated competitive price that covers the costs, and the application of "end-user" clause restrictions to two (Saudi-Arab and Argentina) of four interested customers. The grade of medium is because the variable rests somewhere between these two points.

Q9) Does this agreement obtain financial investment?

Because each country's government has been responsible to finance its own part of the agreement, it is concluded that this variable may be graded as low since the agreement does nothing to enhance the financial viability of the program.

Q10) What are the internal and external political motivations for this agreement?

The political factors have been extremely important in the AMX case. The local production of weapons is frequently a politically feasible way to achieve some technical, economic or military goals. If instead of producing the AMX, the Brazilian Government had just bought the aircraft, this would not have the same political implications. The principal external motivation of working with the Italians has been its neutrality and its alliance with NATO countries. The same occurs with the engine. Both the Italian and British options (European option) have been reciprocated because they are interested in extending the market to South America, and Brazil figures as the most technically prepared partner in the region. The internal motivations of this agreement are complex, but basically the military

and defense industries figure as the most motivated sectors for this program. Recently, this program has been criticized in political debates by the PT (Workers Party) candidate Luis Inácio da Silva, which proposed the application of the funds to social investments [Ref. 25].

Because this agreement was signed when the Brazilian military was in power, few of these internal and external motivations were expressed by government officials. Other sectors have shown some reactions in the recent presidential campaign related to criticism of the previous military regime. The AMX program has been surviving the political transition from the military regime to democracy and certainly will continue to survive, even if future presidents will be against this position, because of the importance of this program for technological evolution, employment generation, exports of high-tech equipment, and other benefits for the national security. This variable is graded as high.

Q11) How does this government act in this offset?

The Brazilian government participation in the AMX program has been similar to developed countries' participation in the development of new weapons systems. This participation has been through negotiating, controlling, and financing. In terms of negotiating, the government has been an active negotiator in all phases of the program and on two basic fronts. First, the government negotiates with the Italian government before the start of each phase of the program. Second, the government has negotiated with the Brazilian companies for the Brazilian share of the work and also for the components produced for the Brazilian version. The government has also been an active comptroller, through the

establishment of contract offices inside the contractor's plant to supervise the contracts of that firm. As they are developed in the U.S., the Grupo de Acompanhamento e Controle (GACs) are responsible to technically and financially certify the overall contract. To finance the contracts, the government has been using similar cost-plus with fixed fee agreements as in the U.S. for the disbursement of funds. Also similar to the U.S., the government has been furnishing GFE equipment and providing facilities for testing of the equipment.

Summing up, the Brazilian government, through the Aeronautics Minister, has been very active in negotiating, controlling, and financing the AMX program, and this variable is graded as high.

Q12) What are the political and social pressures of this agreement?

This coproduction agreement permitted the use of local political pressures to achieve mutual defense goals. The main political pressures of this agreement came from the military and the defense industries. At the time of the agreement, national security related topics and the funds allocated to the program were not presented for Congressional approval. However, as the country is returning to democracy, the Congress and other civilian Ministries have been more active in influencing the program[309].

The social pressures related to this agreement have been increasing since 1980. Today, the AMX program involves various Brazilian industries and

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[309]One example of this power given in part by the new Brazilian Constitution enacted in October 1988, refers to the federal budget. In 1988, the MAER ask for $150 million for the AMX program. The Planning Ministry, responsible for the implementation of the budget cuts, only agreed to $70 million [Ref. 17].

employs lot of workers. Pressure from the people and from the labor unions has been increasing not only in the defense sector but also in all sectors of the Brazilian industry. The evidence of this ascension is the recent position of the Workers Party candidate in the second round of the presidential election.

Because of the increasing political and social pressure on programs like the AMX, this variable is graded as high.

Q13) What are the benefits of this agreement for Industrial defense?

The benefits of the AMX program for the Brazilian aerospace industry are relatively high because of the industrial base and the technology that is flowing within the country. EMBRAER has been one of the main companies to benefit from this agreement. For the first time, the company really has a technologically developed combat aircraft and this has inaugurated a new phase of development for EMBRAER. With experience obtained with the Tucano commercialization, the company engages now in one market that was before dominated only by developed countries companies. EMBRAER has demonstrated itself to be fast and aggressive in using offsets as a marketing tool, as was demonstrated with the Tucano sales to Egypt and U.K. air forces. Other characteristics that are emphasized is the company philosophy in transferring technology. There is nothing better for a third world country than to receive technology from another third world country that has knowledge of the difficulties in the absorption and integration of this technology.

The benefits of the AMX technology are evident in this agreement. The Brazilian companies have been gaining technological known-how, marketing and management expertise. The Brazilian government is obtaining expertise in negotiating large international agreements and in managing large projects. The AMX industrial defense benefits are high.

Q14) Does this agreement bring international prestige?

The Brazilian government is passing through a very turbulent phase, with political changes and serious economic constraints. Although various studies have shown that the new Latin America civilian presidents elected after military regimes did not affect any previous military programs (e.g., in Argentina, the President Raul Alfonsin did not interfere with the Fabricaciones Militares), it seems that the AMX budget program will be affected in the near future, and this may bring serious consequences for the entire program. If this happens, Brazil will lose some international prestige, mainly with its favorite aerospace partner. This will bring serious repercussions for future programs. On the other hand, if despite these problems Brazil continues to produce this fighter, this will bring considerable international benefits and certainly will open the doors for future coproduction agreements such as for the new generation of supersonic aircraft. Even with this uncertainty, Brazil seems to have obtained considerable prestige due to the increasing volume of sales of other equipment. Between the uncertainty of a positive future success of the aircraft and the negative failure of the entire program, medium value is assumed for this variable.

Q15) How does the technology embodied in this offset improve the national military capability?

The incorporation of the AMX fighter in the Brazilian Air Force will represent a new technological level, not only in improving the equipment but also for the combat efficiency of Brazilian military personnel. Fighter pilots, ground support personnel, and supply and administration personnel are being trained to assimilate this new technology. Although the FAB has had some previous experience with Mirage III and F-5E, the AMX is relatively more developed technologically, and the large number of aircraft (79) and the various avionics resources will need more know-how. This probably will require, like EMBRAER, the application of the same step-stone method to prepare the Air Force to receive this advanced equipment[310]. Considering the probability of the expansion of the number of aircraft produced and also the numerous versions estimated for this aircraft (carrier operation, anti-submarine patrol, two-seats) it is easy to assume a high value of contribution of this program for the Brazilian Air Force capability.

Q16) How does this agreement contribute to the country's independence and non-vulnerability?

The AMX program is very powerful evidence of the value of the independence and non-vulnerability concepts. The technology, general expertise, and funds obtained by the aerospace industry to produce the aircraft emphasizes

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[310]The first 9 AMX (in the FAB denomination will be A-1) aircraft will be delivered in 1990 and will be included in the second fighter group in Santa Cruz Air Force Base, Rio de Janeiro. The AMX is the first combat fighter specified by the Air Force.

the importance of the domestic production of military equipment. The **vulnerability** of Brazil is expressed by the diversification of the suppliers ("European choice" instead of the unfeasible U.S. choice) in supplying critical equipments where the indigenous production is technically and economically unfeasible. **Independence** has been demonstrated by the numerous Brazilian companies that are directly and indirectly connected to the program. The diversification of domestic industries such as airframe, aeronautical engines, avionics, communication, electric and electronics, and missiles is a significant step towards the last stage of the technological independence. This program has a high value in terms of contributing to the overall Brazilian independence and non-vulnerability.

OFFSET OUTCOME

The AMX case is a very important example which demonstrates the evolution of the benefits acquired through the different types of offsets. The technology transferred in this agreement has been a function of the government participation, the level of technology, and the leverage of the supplier in relation to recipients in negotiating better terms. The economic benefits of government-to-government agreements are difficult to measure because of the data secrecy, but externalities such as the increasing of employment and exports performance are evidence of the benefits of this program. Finally, national security figures as the most important outcome in military coproduction agreements. Due to the representative amount of funds allocated to these programs, they are exposed to various political and social influences. Table 33 shows the AMX general results.

Q18) Does this agreement provide independent technological capabilities?

The decreasing supremacy of the U.S. as the main supplier of technology is proven by this case. As the transfer of technology becomes tied to strict restrictions, the recipients turn to other options to have flexibility when negotiating the future sales of products. The AMX case is one more step in the new third world country evolution towards independence. The outcome of this case is related to the level of technology as a function of government participation and the existence of the various political and commercial limiting factors (e.g., "end-user" clause) that restrict the maximum technological benefit. Although some of the variables had medium values of contribution, the overall average of this result is considered high, due to the importance of the technology and the tradition of Italy as a reliable supplier. Table 30 shows the independent technological capability outcome.

Table 30

CASE: AMX	
VARIABLES	GRADE
Q17) OFFSET TYPE	COPRODUCTION
Q1) TYPE OF TECHNOLOGY	HIGH
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM

OUTCOME

Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	HIGH

Q19) Does this offset improve Brazilian national security?

The national security results are always emphasized in coproduction agreements between two governments. The AMX is not an exception. The benefits of the AMX program to industrial defense, military capability, and to independence and non-vulnerability prove the success reached by recipient countries. Table 31 shows the national security outcome results for the AMX case.

Table 31

CASE: AMX	
VARIABLES	GRADE
Q10) INT/EXT POLITICAL MOTIVES	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	HIGH
Q14) INTERNATIONAL PRESTIGE	MEDIUM
Q15) MILITARY CAPABILITY	HIGH
Q16) INDEPENDENCE/NON-VULNERABILITY	HIGH
OUTCOME	
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH

Q20) Does this offset improve Brazilian economic capability?

The results obtained concerning economic benefits are tentative due to lack of accurate data in government agreements involving the transaction of high technology weapons. Most of this secrecy is due to the internal political reaction if these data were to be published. The IMF has been very critical of military expenses in countries with high external debt, and certainly this is one more reason to keep the data from becoming public. The most important economic benefit of the AMX has been the creation and improvement of the aerospace industry worker in Brazil, one of the most important industries in terms of technology level. Other benefits such as export expansion are seriously challenged by the restrictions imposed by the suppliers and the economic situation of the country in general. The

overall impact of this variable is medium. Table 32 shows the economic benefits outcome obtained by the AMX case.

Table 32

CASE: AMX	
VARIABLES	GRADE
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	HIGH
Q8) EXPORT EXPANSION	MEDIUM
Q9) ENHANCE FINANCIAL VIABILITY	LOW

OUTCOME

Q20) ECONOMIC BENEFITS	MEDIUM

Table 33

CASE: AMX	
VARIABLES	GRADE
Q17) OFFSET TYPE	COPRODUCTION
Q1) TYPE OF TECHNOLOGY	HIGH
Q2) TRANSFER ENVIRONMENT	MEDIUM
Q3) RECIPIENT'S CHARACTERISTICS	MEDIUM
Q4) SUPPLIER'S CHARACTERISTICS	HIGH
Q5) TECHNOLOGY INTEGRATION	MEDIUM
Q6) FOREIGN EXCHANGE SAVINGS	LOW
Q7) JOBS CREATION	HIGH
Q8) EXPORT EXPANSION	MEDIUM
Q9) ENHANCE FINANCIAL VIABILITY	LOW
Q10) INT/EXT POLITICAL MOTIVATION	HIGH
Q11) GOVERNMENT ACTION	HIGH
Q12) POLITICAL AND SOCIAL PRESSURES	HIGH
Q13) INDUSTRIAL DEFENSE	HIGH
Q14) INTERNATIONAL PRESTIGE	MEDIUM
Q15) MILITARY CAPABILITY	HIGH
Q16) INDEPENDENCE/NON-VULNERABILITY	HIGH

OUTCOME VARIABLES	GRADE
Q18) INDEPENDENT TECHNOLOGICAL CAPABILITY	HIGH
Q19) ENHANCEMENT NATIONAL SECURITY	HIGH
Q20) ECONOMIC BENEFITS	MEDIUM

VI - CASE STUDIES ANALYSIS

The technological, socio-political, economical, and military factors that motivate recipient countries to participate in offset arrangements were analyzed applying six case studies from the Brazilian aerospace industry. The methodology applied was a focused comparison (case study methodology) which consists of asking a set of standardized questions for each case. This procedure assures that the data obtained from various cases are comparable. This chapter provides a general analysis of the foregoing case studies including an examination of the hypotheses previously established and makes some generalizations based on the four headings described in Chapter One.

A. GENERAL ANALYSIS

The results of the case studies are summarized in Table 34 through Table 38. The tables show an overview of different relationships between offset cases and their independent variables (Table 34), offset cases and their outcomes (Table 35), offset types and their outcomes (Table 36), offset cases and general outcome (Table 37), and an additional time period and case type variables (Table 38). Based on these tables' results, some valuable findings were obtained through the test of hypotheses established in Chapter One. All the cases were grouped in four types of offsets (countertrade, technology transfer, licensed production, and coproduction) and each of the hypotheses are examined under these groups. At the end of this section, Table 39 will summarize the results of the hypotheses tests.

1. Hypotheses and General Analysis

This thesis examines six hypotheses:

- **H1:** IF variance in **experience in negotiating offsets** affects the **offset outcome**, THEN there is a learning process in recipient countries offset negotiations, which will result in increasingly beneficial offsets over time.

- **H2:** IF variance in **types of offset agreements** affects the offset outcome, THEN there is a trend that shows an evolution among different agreements.

- **H3:** IF variance between **military and civilian offsets** affects the offset outcome, THEN the government should give different treatment to civilian and military offset policy (different legislation, assistance, financial support, etc.).

- **H4:** IF variance in **level of technology** affects the offset outcome, THEN there is a hierarchy among different offset agreements (i.e., some offset agreements are able to transfer technology better or more efficiently).

- **H5:** IF variance in **government support** affects offset outcome, THEN defense industries should search for offset agreements with government support (i.e., there is some suspicion that recipient industries have more leverage in negotiating offsets if they have their government involved).

- **H6:** IF variance in **supplier countries and industries** affects offset outcome, THEN recipient governments and industries should develop "supplier scores" to improve decision making (e.g. a databank with previous information by country and by industry, about implementation, policies, trade barriers, etc.).

TABLE 34

VARIABLES/CASES	MD-11	BRASILSAT	PIPER	AEROSPATIALE	CBA-123	AMX
OFFSET TYPE	CT	TT	LP	LP	CP	CP
TYPE OF TECHNOLOGY	LO	MD	MD	MD	MD	HG
TRANSFER ENVIRONMENT	HG	MD	HG	MD	MD	MD
RECIPIENT'S CHARACTERISTICS	MD	MD	HG	LO	HG	MD
SUPPLIER'S CHARACTERISTICS	HG	MD	HG	MD	MD	HG
TECHNOLOGY INTEGRATION	MD	HG	MD	MD	MD	MD
FOREIGN EXCHANGE SAVINGS	LO	MD	HG	LO	HG	LO
JOBS CREATION	LO	MD	MD	MD	MD	HG
EXPORT EXPANSION	MD	LO	LO	LO	HG	MD
ENHANCE FIN. VIABILITY	LO	MD	UN	UN	HG	LO
INT/EXT. POLITIC MOTIVATION	MD	HG	MD	HG	HG	HG
GOVERNMENT ACTION	MD	HG	HG	HG	MD	HG
SOC/POL. PRESSURES	UN	HG	MD	HG	MD	HG
INDUSTRIAL DEFENSE	NA	MD	NA	MD	HG	HG
INTERNATIONAL PRESTIGE	NA	HG	NA	LO	HG	MD
MILITARY CAPABILITY	NA	MD	NA	HG	MD	HG
INDEP/NON-VULNERABILITY	NA	MD	NA	MD	MD	HG

LO : LOW
MD : MEDIUM
HG : HIGH
UN : UNKNOWN
NA : NOT APPLICABLE
CT : COUNTERTRADE
TT : TECHNOLOGY TRANSFER
LP : LICENSE PRODUCTION
CP : COPRODUCTION

TABLE 35

OUTCOMES/CASES	MD-11	BRASILSAT	PIPER	AEROSPATIALE	CBA-123	AMX
TECHNOLOGICAL INDEPENDENCE	MEDIUM	MEDIUM	HIGH	MEDIUM	MEDIUM	HIGH
ENHANCE NATIONAL SECURITY	MEDIUM	HIGH	MEDIUM	HIGH	MEDIUM	HIGH
ECONOMIC BENEFITS	LOW	MEDIUM	MEDIUM	LOW	HIGH	MEDIUM

TABLE 36

OUTCOMES/OFFSET	COUNTERTRADE	TECH.TRANSFER	LICENSED PRODUCTION(*)	COPRODUCTION(**)
TECHNOLOGICAL INDEPENDENCE	MEDIUM	MEDIUM	MEDIUM	MEDIUM
ENHANCE NATIONAL SECURITY	MEDIUM	HIGH	HIGH	HIGH
ECONOMIC BENEFITS	LOW	MEDIUM	LOW	MEDIUM

(*) SELECTION CRITERIA BETWEEN THE PIPER AND AEROSPATIALE CASES, LOWEST GRADE
(**) SELECTION CRITERIA BETWEEN THE CBA-123 AND AMX CASES, LOWEST GRADE

TABLE 37

OUTCOMES/OFFSET	COUNTERTRADE	TECH.TRANSFER	LICENSED PRODUCTION	COPRODUCTION
GENERAL OUTCOME(*)	LOW	MEDIUM	LOW	MEDIUM

(*) SELECTION CRITERIA, LOWEST GRADE FROM TABLE 3

TABLE 38

CASE STUDIES ADDITIONAL VARIABLES

VARIABLES/CASES	MD-11	BRASILSAT	PIPER	AEROSPATIALE	CBA-123	AMX
Y E A R	1987	(1990)	1974	1988	1987	1980
CASE TYPE	CIVILIAN	CIV/MIL.	CIVILIAN	MILITARY	CIV/MIL.	MILITARY

2. Countertrade

This offset group is represented only by the MD-11 case, thereby limiting the generalizations which can be made. The following findings summarize the examination of the various hypotheses under this offset group:

(1) H1 is partially supported in the MD-11 case. It seems that there is a MAER learning process when offset negotiations involve commercial jet acquisitions for airlines. This evolution is demonstrated in the specific government offset policies for countertrade negotiations. However, the legislation enacted by the MAER is finding a lack of support because the offset benefits are not completely understood within the government. As a result, the DAC has been using small requirements (e.g., 10% of percentage of offset) to test the acceptability of this policy by the suppliers as well as other government agencies.

(2) Countertrade agreements are the weakest in terms of obtaining technology, supporting hypothesis 2. The MD-11 is a good case to show this effect. Because of the Brazilian aircraft industry's technological and production limitations and McDonnell Douglas' high technological level requirements, the countertrade agreement seems to be the best arrangement that could have been made. The small Brazilian component producers cannot technically compete to supply equipments for a MD-11 aircraft. EMBRAER is working close to total capacity filling aircraft orders and cannot incorporate new component jobs to support offset implementations. With this limitation, the Brazilian government cannot negotiate to improve the amount and the level of technology transfer to higher levels such as coproduction. Considering just countertrade, there is an

evolution from barter (practically no technology transfer involved) to buy-back (maximum of technology transfer under the countertrade group) agreements. The MD-11 represents the upper bound of this evolution, because it includes a small portion of technology transfer to produce components for the same aircraft (buy-back arrangement), instead of a simple barter or counterpurchase transactions. The utilization of direct offsets (flaps are related to the MD-11 acquisition) increase the probability of obtaining better terms in technology transfer. H2 is strongly supported by the MD-11 case.

(3) The military and civilian offset agreements are commonly not well distinguished under countertrade agreements because of the variety of forms that these arrangements may assume. Offsets being linked to items not related to the equipment sold is becoming very common (e.g., the acquisition of F-16 by Greece which includes Greek tourism as offset). In fact, the MD-11 is easily identified as a civilian case, which is regulated in Brazil by a completely different set of government regulations. The case shows the importance of distinguishing between military and civilian offsets and the government's need to apply different policies for each case. The Brazilian government recognized this difference, publishing civilian offset policy guidelines and keeping a "case-by-case" approach for military decisions. H3 is supported in this case.

(4) Countertrade agreements usually involve a low level of technology which directly affects the technological independence and economical benefit outcomes. In this case, the technological independence does not assume an extremely positive value because EMBRAER already had the capability to produce

flaps using composite material technology. It does not seem that a higher level of technology would be obtained through a countertrade agreement negotiated for only 10% of the requirements of the total value of the acquisition. The economic benefits expected in this negotiation offer evidence that this limited requirement negatively affects the economic outcome. In summary, because of the low level of technology transferred and the weak economic benefits obtained due to low offset requirements, H4 is supported in the MD-11 case.

(5) Although the Brazilian government has been deeply involved in offset arrangements, its participation in the countertrade transactions has been somewhat limited. It seems that the government only partially participated in the negotiation of this agreement and has been controlling just the formal process of this offset agreement according to the respective legislation. H5 is not confirmed in the MD-11 case, because EMBRAER and VARIG companies had acted independently without government support.

(6) The actual level of fierce competition in the international aerospace market is increasing the number of offset proposals among different suppliers. It is assumed that one of the main reasons McDonnell Douglas won this competition and sold the aircraft was due to its position in having already contracted with EMBRAER, fulfilling a previous offset requirement. It does not seem that McDonnell Douglas had presented significative proposals in relation to other companies' proposals (e.g., Boeing). Hypothesis 6 is not supported by this case.

3. Technology Transfer

BRASILSAT agreement is the only case in this offset group. However it is a very powerful case of technology transfer and it becomes very relevant to most of the hypotheses of this thesis since it is a civilian and a military case at the same time.

(1) H1 found in this case its strongest support. The evolution from the first generation BRASILSAT negotiation in 1982 and this case in 1989 is very clear. This evolution demonstrates the increasing level of technology transfer involved in offset proposals. However, this intended outcome has been seriously challenged because of numerous restrictions placed on the transfer of missile technology to Brazil. With the results obtained in this offset agreement negotiation, Brazil may be engaged with countries having strict offset requirements which will positively reflect on the learning process in future negotiations.

(2) H2 is strongly held by this case, due to the satellite portion of the offset proposal which includes offers for the counterpurchase of auto parts or Tucano aircraft. If the acquisition remains divided into two agreements there will be a technology transfer agreement for the rocket technology and a countertrade agreement in exchange for auto parts and Tucanos. As mentioned in the MD-11 case, what constrains the evolution from technology transfer to license and coproduction agreements is the low level of technological capability of the Brazilian rocket industry. Because of the different outcomes that may be obtained through the signature of the contract, even with this technology limitation, this case strongly supported H2.

(3) The dual military and civilian objectives of the satellite and rocket technologies make this case particularly relevant to Hypothesis 3. The political and military influences are balanced in this case due to the Brazilian space program division of labor. The same occurs in other programs such as the Brazilian nuclear program where the power plants share the same nuclear weapon laboratory. It is obvious that for a government, it is very hard to give different treatment to these programs, establishing different civilian and military offset policies. However, the BRASILSAT case demonstrates the constant conflict between these two groups with opposing views for the same objectives, which support the hypothesis that different treatment should be given to military and civilian offsets.

(4) The level of technology that would be transferred through the BRASILSAT agreement will determine the validity of hypothesis 4. The choice of old rocket technology from France instead of the U.S. know-how will produce intense variances in the technological independence and national security outcomes. This difference in outcomes is the evidence that H4 is true.

(5) The BRASILSAT case shows an impressive participation of the Brazilian government due primarily to the wide variety of political motivations and pressures. The huge responsibilities of civilian and military ministries in supporting this agreement are of fundamental importance for the implementation of the entire program. Because of the vital government support in this agreement, hypothesis 5 is supported for this type of offset.

(6) H6 also found in this case significative support. The difference encountered between the French and the U.S. offset proposals certainly will affect

the technological independence and national security outcomes and indirectly may affect the future economic benefits through the foreign exchange savings. Because of the difference in the outcomes as a function of probable suppliers for this agreement, hypothesis 6 is supported in this case.

4. Licensed Production

The utilization of two important licensed production offsets from the Brazilian aerospace industry were carefully planned to allow adequate testing of the proposed hypotheses.

(1) Both cases show mixed results regarding H1. The Piper case demonstrates a significative evolution from previous agreements such as the Xavante licensed production with the Italian Aermacchi. The prohibition of royalties and the authority needed to make changes in the product for better adaptation to Brazilian conditions are evidence of an evolution of better terms in the transfer of technology. The Aérospatiale military helicopters case seems to show just the opposite, since the first agreement which resulted in the creation of HELIBRAS in 1980 had better terms than this case. Very little experience seems to be have been incorporated in the second agreement. Because of these opposite views, H1 is considered true only in some cases and further testing is required.

(2) Both cases of licensed production strongly support H2. Because of the strict technological and market limitations required by licensed production agreement clauses, the outcome is always exposed to some limitations. For example, the Piper commercial clause which restrict export certainly negatively affects the economic benefits outcome. The same occurs with the Aérospatiale

case where HELIBRAS shows deficiencies in absorbing the technology. These limitations also will affect negatively the technological independence outcome. Although the technology independence outcome obtained in licensed production is higher than countertrade and technology transfer agreements, the overall results show that this type of agreement is still lower than coproduction. Because of this variation in the offset outcome caused mainly by various limitations under these agreements, H2 is strongly supported by both case studies.

(3) The two cases under the licensed production were carefully chosen to show the variance between the civilian and military offset agreements to support H3[311]. The Piper case is a typical civilian case of licensing between firms and it was affected by the Brazilian technology transfer and trade regulations (e.g., the Brazilian government had established tariff barriers for import of general aviation planes and prohibition of royalties payments). Instead, the Aérospatiale case seems not be affected by the same policies and regulations[312]. It is obvious that each case shows completely opposite outcomes (Table 35) because of some variables such as transfer environment, recipient characteristics, and domestic political motivations (Table 34). The difference between the two government treatments offered to civilian and military cases supports H3.

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[311]The reader should remember that under OMB definitions, the Aérospatiale case is considered as coproduction because it is a government-to-government agreement.

[312]For example, the same trade barrier used to general aviation planes is used for helicopters, but the enforcement seems more flexible, allowing Brazilian purchasers to specify helicopters above the technological level of HELIBRAS production to justify the equipment import.

(4) The level of technology transferred through licensed production agreements does not seem to be a factor that largely contributes to support H4. Most of the technology transferred through these offsets refers to assembly, test, maintenance, and a very little portion of production. The Aérospatiale case shows that even if the level of equipment technology improves, little will be added to the general outcome. However, the Piper case shows that if variables such as transfer environment, and recipient and supplier characteristics have a positive values, the consequent technological outcome will be as expected. Because of these two opposite situations, H4 is true only in certain types of cases.

(5) Although recipient governments have distanced themselves from civilian offsets, these case studies show an opposite picture. The case of Piper illustrates the indirect way which governments may act to improve the offset outcome. These methods include the establishment of protectionism laws ("law of similars"), tariff barriers, and even through the acquisition of some products (e.g., FAB bought some Piper models to incorporate in the fleet). These types of "little help" from the government may improve the offset outcome. Since the Aérospatiale case is a military case, the Brazilian government has been deeply involved and the outcomes will be positively increased compared to the first HELIBRAS agreement. The "Army factor" in this case is a proof of this new relationship. Another important point under this hypothesis is the political influence of the industry involved in the license production. The best example of this point is the "ENGESA factor" and its power to have the government act as a partner. In summary, the case studies

show the importance of the government in supporting the agreements, even the civilian related ones.

(6) H6 is strongly demonstrated through the two examples of licensing. It is clear that there are differences between government and industry suppliers from different countries. Under this offset group, two different technology transfer policies may be ascertained. First, there is U.S. technology for general aviation planes production. This technology is commercially restricted (and most of the time restricted for national security reasons) but represented the most advanced technology available in this area. The French technology for helicopter production comes free of political ties but it is not a leading-edge technology. These variations suggest a constant trade-off in recipient country decision making and shows H6 to be true.

5. Coproduction

Coproduction agreements are different from other types of offset because of the mutual benefits provided to both partners. The two cases selected for study under coproduction support some of the hypotheses of this thesis, although the lack of available information restricted most of the AMX case analysis.

(1) H1 is not well supported by this group of cases. Although EMBRAER and the Brazilian government agreements have been evolving from license agreements to coproduction, it cannot be assumed that coproduction agreement terms will continue to improve in future coproduction arrangements (e.g., the new fighter agreement may be successful in obtaining an increase of worksharing or

more sophisticated technology, but there is no basis to assume this evolution). Another approach may be analyzing the terms which have evolved from the AMX agreement (1980) to the CBA-123 (1987). It seems that the main lesson learned by EMBRAER during this time period was the importance of having a large share in coproduction agreements. Because of this lack of basis to assume future evolutions under coproduction agreements and the difficulty in comparing the two cases due to their differences (e.g., in AMX case, EMBRAER is the recipient and in the CBA-123, it is more of a supplier), H1 is only partially supported.

(2) The two cases seem to partially support H2, because of the high level of benefits obtained through these agreements. From the point of view of a recipient country, coproduction is the best approach in receiving high technology (see Table 36), which effectively contributes positively to the other outcomes. The AMX case is very rich in showing the importance of the worksharing participation in improving variables such as transfer environment and technology integration. Although the CBA-123 has a different prospective because Brazil is more of a supplier than a recipient, the same worksharing principle is applied to assure at least some flow of technology from Argentina, establishing a "two-way street". The evolution observed in these agreements cannot be compared because of the differences existing between them such as military and civilian, government support, and level of technology. Because of the infeasibility of comparing these two cases, H2 is only partially supported.

(3) The selection of two coproduction cases with different civilian and military objectives has been successful in showing support for H3. The differences

observed between the two cases show a technology and economic benefits trade-off (Table 35). It means that with the AMX program Brazil has benefited more with technology and less with economic outcome while the CBA-123 has an opposite picture. These differences are enough to support hypothesis 3.

(4) The difference between the level of technology of the two coproduction agreements cases (Table 34) produced different outcomes (Table 35). The technology transferred through the AMX case is higher than in the CBA-123 case, which positively affects the technological independence outcome. This variation in the outcome is proof that hypothesis 4 is true.

(5) H5 (government support) variance between the two cases is once again supported through these two examples of coproduction offset. The difference between the level of government action (Table 34) in the CBA-123 and AMX cases directly affected the outcome results (Table 35). Although the CBA-123 was considered partially a military agreement, the government involvement has been restricted to acquisition of some units to guarantee the launch of the program.

(6) Argentina and Italy and respective companies engaged in both coproduction agreements figure as examples of the effect of variance in supplier countries and industries on the outcome, showing H6 to be true. The CBA-123 case is somewhat weak because FAMA is not totally a supplier in this agreement, and this may have influenced negatively the outcome. However, the AMX case shows the importance of the supplier in positively affecting the technological independence outcome. Because of the difference in the role of the suppliers in these cases, H6 is considered supported by both agreements.

6. Summary of the Hypotheses Results

Table 39 provides a summary of the hypotheses test results by type of offset. A plus (+) indicates the hypothesis was strongly or simply supported. A minus (-) shows that the hypothesis was only partially or not supported by the case studies.

Table 39

SUMMARY OF HYPOTHESES RESULTS

OFFSET/HYPOTHESES	H1	H2	H3	H4	H5	H6
COUNTERTRADE	-	+	+	+	-	-
TECHNOLOGY TRANSFER	+	+	+	+	+	+
LICENSED PRODUCTION	-	+	+	-	+	+
COPRODUCTION	-	-	+	+	+	+

The general hypotheses results offer important findings of this thesis which are listed below:

-- Technology transfer cases, represented basically by the BRASILSAT case, supported most of the hypotheses previously posited. The hypotheses were generally not true for the countertrade cases.

-- The hypotheses H2 (type of offset agreement), H3 (military and civilian offsets), H5 (government support) and H6 (supplier countries and industries) were supported in more than 75% of the cases (more than three pluses (+) in Table 39).

B. GENERALIZATIONS

The foregoing case studies provide some findings regarding the technological impact of offset agreements in recipient countries. The generalizations relate to four significant issues: the determinants of offset requirements, the relationship of different factors, the link between offsets and technology transfer and effective policies for a recipient developing country.

1. What are the determinants of offset requirements?

The first set of generalizations suggested by this thesis is related to the question: What are the principal factors that motivate recipient countries to set offset requirements? The relationship between the supplier and recipient in negotiating offsets does not seem to be random. The operating decisions about the best offset proposals also seem to obey a certain framework. A systems view of the major factors in this decision-making, which emerges from the case analysis is helpful in analyzing future cases. The four factors involved in every offset decision making for a recipient country are: technological, socio-political, economical, and military. These factors influence three main outcome dimensions which represent the value of these offsets to the recipient country. The outcome dimensions are technological independence, economic benefits, and the enhancement of national security.

The first outcome, technology independence, as was proposed at the beginning of the research, is considered the most important one, although the case studies have proven that enhancing national security has been the emphasis in the Brazilian aerospace offset cases. This thesis concludes that the most

important variable considered under this outcome is the type (or level) of the technology included in the transfer of the technology.

The second outcome is economic benefits. This is an important outcome for countries that have high external debt, but in this study was not considered so important to Brazil. However, recipient countries recognize the importance of future exports and seek to turn the technology obtained through these offsets into commercially viable exports. The difficulty in obtaining information about the financial arrangements included in offsets was one aspect that may have contributed negatively to this outcome.

The last outcome is the enhancement of national security. The combination of the socio-political and military factors as predictors of one broad outcome called national security was due to the similarity of these two factors. The flexibility of the model allowed the analysis of cases with both military and civilian characteristics. The results demonstrate that this outcome has been obtained in most of the offsets agreements in Brazil.

2. What is the relationship of different offset factors?

The role of these four main factors in offsets were studied in detail in this thesis. The variables that constituted these factors were sometimes difficult to differentiate. For example, it is difficult to differentiate **industrial defense** from **military capability** because these concepts are interconnected through "mobilization". The same occurs with the **internal and external political motivations** and **socio-political pressures** where external politics have been strong enough to influence internal politics (e.g., the IMF exerts influence in

national decisions about investments). The following list summarizes some of the relationships identified through the research on these main factors.

-- Supplier characteristics are related to the type of technology. It means that some suppliers are allowed to transfer technology more easily than others. The U.S. and French cases were the most evident in arriving at this finding.

-- Government action is related to the level of technology that is transferred to the recipient country. Coproduction agreements which involve strong government participation are more flexible and more likely to improve the quality and quantity of technology.

3. What is the link between offsets and technology transfer?

The role of technology in offset agreements was the main goal of this thesis. The conclusions of this research indicate that offsets are an efficient way for recipient countries to obtain high technology. It was observed that there is a hierarchy among offset agreements in their capacity to acquired technology. From the four offset groups analyzed, countertrade had a low capacity, technology transfer and licensed production medium capacity, and coproduction high capacity. This hierarchy suggests that recipient countries should start their technological development through offsets that bring low technology and improve the level of the agreements as their technological level improves.

Another point emphasized in the offset and technology transfer relationship was the importance in having a propitious technology transfer environment and a previously established recipient firm technological capacity. Offset agreements are inefficient if they do not have these favorable aspects.

Finally, it was observed that a successful level of technological independence depends basically on other key variables such as government support, socio-political pressures, and jobs creation. The results from the case studies proved the importance of the government participation in the process to coordinate offset negotiations because of various impacts of these agreements in other sectors of the society.

4. What are effective policies for developing countries?

This study about recipient country motivations towards offset agreements suggests a set of general policies that may be used by developing country governments to increase the benefits of these agreements.

It was identified that there is a definite difference in recipient countries offset objectives. Developed countries have strong concerns about employment and technology transfer while developing countries are always concerned with the financial viability and increase of the balance of payments position. Developing countries are also constrained in entering in these kind of negotiations due to financial institutions such as the IMF. However, the research suggests the following developing country offset policies.

-- The recipient government should emphasize direct offsets because they improve the level of technology transfer and are easier to follow.

-- The government should issue general guidelines to direct supplier and recipient firms about the level of desired impacts in the recipient economy. The establishment of details such as the percentage of offset obligations does not

seem to be adequate policy. These general guidelines should contain the government sectors responsible for supervising these agreements.

VII - CONCLUSION

The purpose of this thesis about offset agreements was to further identify what kind of factors affect decision-making involving technology transfer in recipient countries. In addition, this research was undertaken in order to determine the impact of offset agreements on the technological process of developing countries and to draw from the analysis of some cases broader theoretical implications about technology transfer for explaining and predicting future offset negotiations. These statements and goals led to the development of an analytical model which identifies economic, socio-political, military, and technological factors (independent variables) that influence three main outcomes: technological independence, national security, and economic benefits.

The Brazilian aerospace industry was an appropriate source of case studies which provided relatively rich analysis within the constraint of a lack of accurate data. The cases also offered interesting findings and supported most of the six hypotheses previously established. Finally, they provide a basis for formulating generalizations which may be applied to other recipient countries.

The theoretical framework based on the focused comparison method demonstrated the efficacy of the empirical inquiry method in handling very complex issues related to contemporary phenomena. The method based on formulating standard questions for each of the cases assured that similar criteria would be used to analyze cases with different characteristics such as: type of offsets, military or civilian related, government support, level of technology, and supplier origin. The

utilization of a system of grades (low, medium, and high) attributed to each variable helped to ascertain the extent of their contribution to the outcomes.

This chapter concludes the thesis. It provides a summary of findings, recommendations to improve the Brazilian government offset policy, and suggestions for further research in this area.

A. SUMMARY OF FINDINGS

This thesis produced some important findings that will contribute to further experiments into the offset agreements area. The following list summarizes these main findings:

-- Offsets have become an efficient way to bring high technology to developing countries.

The Brazilian government has utilized offsets in a large scale in the aerospace industry to facilitate and to improve the transfer of advanced technology. This is what its industry needs to continue being competitive in international markets.

-- The level of technology transferred to recipient countries is related to the type of offset arrangement used.

The utilization of four different groups of offset agreements in this thesis demonstrated that there is a hierarchy of offset types and their capabilities for acquiring technology. This thesis also showed that the level of technology acquired depends also on the level of the recipient industrial base. It means a recipient country can obtain technological benefits from an offset agreement only if it has the technological capacity already installed. The thesis also suggests that developing

countries should start with countertrade, moving to licensed production, and coproduction as the level of its industrial base improves.

-- Offset agreements have been used successfully in Brazilian aerospace programs and they have had a major impact on the technological status of the Brazilian industry.

Despite numerous controversial opinions about offsets not only inside the Aeronautics Ministry but also in the other government sectors such as CACEX, these kind of negotiations have been very common in the majority of recent big aerospace contracts. Most of these agreements have been used as an efficient way to get technology and to finance production. The technology obtained through these agreements has been transferred to other industries with tremendous spinoffs effects, causing multiplier effects such as creation of jobs, increasing exports, and distribution of technology.

B. RECOMMENDATIONS TO IMPROVE THE BRAZILIAN OFFSET POLICY

Because offsets are elaborate, inventive, and extremely diverse, they allow an infinite combination of different policies which make a recipient country's national offset policy somewhat complex. However, if experiences from other countries are studied adequately, they may offer excellent guidelines to be applied in identical situations. The recommendations from this thesis are divided into two levels, which include a national policy for the Brazilian government and a sectoral policy for the Aeronautics Ministry. Both groups of recommendations are related to the main findings of this research.

1. The National Policy Recommendations

Some governments have promulgated regulations requiring offsets in certain circumstances, but most of the recipients are confused with the more appropriate approach. Proposing a Brazilian national offset policy is a somewhat complex task given the limited observations offered by these case studies. There is currently no Brazilian offset policy in place, and a case-by-case approach is used in most of the negotiations. Various specialists criticize this policy because it does not allow the supplier and recipient industries to forecast what will be the next "surprise" of the Brazilian government. Each agreement is completely different from each other, and this contributes to creating an environment of uncertainty which increases the risks and consequently the price of doing business in Brazil. Although it has numerous drawbacks, this policy may not be totally wrong. Based on the analytical observations of this thesis, a list of general recommendations is produced.

(1) The Brazilian government should issue or announce through its embassies a "Brazilian National Offset Policy" containing general guidelines relating to such topics as technology transfer, financing arrangements, minimum employments benefits, and import and export objectives. Following these guidelines, government agencies should be identified to provide supplier and recipient industries assistance and advice;

(2) The coordination of this policy should be under a Commission represented by the ministries of Technology, Commerce and Industry, Economy,

and Foreign Affairs, besides the Military ministries when offsets were military related;

(3) The Brazilian government should recognize that offsets are a force in the world today that cannot be ignored. If they are not considered, Brazil would have a risk of losing important opportunities to improve its position as an important arms supplier, in spite of the its actual economic position.

2. Sectoral Policy Recommendations

The sectoral policy recommendations focuses on some general guidelines suggested to the Aeronautics Ministry which are divided in civilian and military offset agreements.

a. Civilian Offsets Guidelines

The civilian offset guidelines focuses on the acquisition of civilian aircraft to equip the Brazilian airlines. This part is also under the responsibility of the Aeronautics Ministry (MAER).

(1) The MAER should restrict its participation in controlling offset implementations through a debit/credit account system, functioning as a main source of information and advice about suppliers government and industries offset and technology transfer policies. It should be clear to the recipient firms that the MAER interference is only to give more flexibility to the process and improve their leverage in negotiating better offset terms;

(2) The offset program should be recognized as a part of the long term aerospace industrial policy and not just a short term commercial policy. This

means that special focus should be given to agreements which improve the technological and production level of the aerospace industry;

(3) The MAER should establish a division of labor with other Brazilian government sectors based on specialization of each sector and their offset implementation goals. For example, the MAER may use the marketing network and commercial expertise of INTERBRAS;

(4) A smart offset policy could employ a mixed portfolio approach to offsets that would have a combination of some with immediate impact, some middle-range advantage, and some long term growth. Another possible combination is by mixing direct and indirect offsets to maximize the benefits that offsets can provide;

(5) The SCC (DAC) should provide a "list of preferences" to suppliers as a suggestion for offset obligations, based on the hierarchy of benefits previously forecasted. This list would include not only the aeronautical products but also other kind of services (e.g., VARIG may sell tourism packages in offset for aircraft acquisition). A dollar-for-dollar offset credit relationship should be adopted because this will give more flexibility and open up potential gains in more than just one factor (e.g., foreign exchange savings and technology may be combined as the main objectives in one offset agreement); and

(6) Offsets in the international aerospace sector are a common way of doing business and widely practiced. Instead of fixing a 10% minimum requirement while other countries are operating above 100% figures, an open offset amount may be negotiated or dictated on a "case-by-case" basis. Offsets are a

rapidly growing phenomenon in the international political economy and the MAER civilian offset policy should follow this rapid evolution closely.

b. Military Offset Guidelines

The military offset guidelines are suggested to improve some offset negotiations involving the acquisition of new weapons systems or transfer of military-related technologies.

(1) Military offsets are not being used to improve the Brazilian Armed Forces military capability because of the lack of budget funds allocated to improve the arsenal. Because of this, coproduction of high technology weapons has been the best approach. However, these programs are restricted to producing a limited number of weapons, which increases the unit price to uncompetitive levels for export. Future agreements should emphasize larger workshares based on technologies which the industry may use for competitive advantage in potential exports;

(2) Military offset programs should be negotiated into ones that require less foreign exchange, quicker return on investment, and mainly, offer potential export earnings. These requirements may improve the technological and economical benefits to justify the investment and make the program politically viable;

(3) The MAER expertise in negotiating offsets within the aerospace area seems to be now very useful to the Brazilian Navy and Army as they start creating airmobile and tactical capability into their services. The MAER advice to

other services will contribute to increasing their bargaining power and directly improve the aerospace industry;

(4) Offsets could allow the recipient industries to engage in programs above their capacities and this may increase the risks. Offsets can finance ambitious programs of industrialization without bankrupting the recipient economy or destabilizing its government. However, as the political support changes, these unrealistic programs may be considered an unnecessary burden and be cancelled if the technological and economical justifications won't support them;

(5) The MAER should continue looking towards offset as one of the ways to stay technologically afloat in the current doldrums of international trade, technological evolution, and military defense.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

Potential topics for further research stemming from the analysis and limitation imposed by time in this thesis include the following:

1. To improve the technological impact of offset agreements assessment, it may be necessary to extend the data access and the analysis to specific points such as spinoffs, R & D investments, employment qualitative effects, etc;

2. An analysis applying linear programming models may help recipient countries decision-making related to technology transfer packages. This could provide an optimization of available resources and technology limitations;

3. Technology forecasting models may be applied to estimate future recipient countries' decisions related to offset requirements;

4. Risk assessment models may be used by recipient countries to estimate the risk in obtaining a certain technology and completely integrated, using different types of offsets agreements;

5. Specifically in Brazil, similar research may be conducted on other industries such as the nuclear industry, which also shows mixed civilian and military objectives, offering options to compare different types of offsets;

6. There is a hypothesis not tested that recipient government participation in offset negotiations may provide an increase in the percentage obtained by these countries in offset obligations. If this hypothesis could be statistically tested, it will contribute significantly to recipient government policies towards offset agreements.

The major conclusion of this thesis is that developing countries have a limited capability for diagnosing the problems and benefits of offset agreements and little understanding of how the transfer of technology can be implemented through these arrangements. This thesis concludes that offset is a complex issue coupled with a turbulent environment in which countries such as Brazil must operate. This scenario may explain why some recipient countries have a weak commitment to planning and setting long range offset and technology transfer goals. After this extensive research, one question still remains to be further explored. How does technology relate to offset arrangements in the arms trade?

APPENDIX A - ABREVIATIONS

ACDA - U.S. Arms Control and Disarmament Agency

CACEX - Brazilian Trade Department

COPAC - Commissão Organizadora do Program Aeronave de Combate

COTAC - Comissão de Coordenação de Transporte Aéreo

CTA - Aerospace Technical Center

DAC - Department of Civilian Aviation

DOD - U.S. Department of Defense

EMBRAER - Empresa Brasileira de Aeronáutica

FAB - Brazilian Air Force

GAC - Grupo de Acompanhamento e Controle

GATT - General Agreement on Tarrifs and Trade

GFE - Government Furnished Equipment

IAE - Institute of Space Activities

IEAv -Institute of Advanced Studies

IFI - Institute of Industrial Foster

IMF - International Monetary Fund

INPE - National Institute of Space Research

INPI - National Institute of Industrial Property

IPD - Institute of the Research and Development

ITA -Institute of Technological of Aeronautics

MAER - Brazilian Aeronautics Ministry

MCD - McDonnell Douglas

MTCR - Missile Technology Control Regime

NASA - National Aeronautics and Space Administration

NATO - North Atlantic Treaty Organization

NPT - Non-Proliferation Treaty

OECD - Organization for Economic Cooperation and Development

OMB - Office of Management and Budget

OPEC - Organization of Petroleum Exporting Countries

R & D - Research and Development

SIPRI - Stockholm International Peace Research Institute

APPENDIX B - BRASILSAT BIDDERS PROFILE[313]

HUGHES

Hughes Aircraft Company, specifically the Hughes Space and Communications Group, located in El Segundo, California is specialized in the development and production of Earth satellites for telecommunications, Earth observation and meteorology, and vehicles and payloads for space exploration. The group also manufactures Earth terminals and related communications equipment. Hughes has been involved in many of the domestic and overseas satellites programs, starting with Syncom 2, the world's first geosynchronous communications satellite. The most purchased commercial communications satellite series, the HS376, is an advanced two-axis spin-stabilized satellite which has been supplied to the USA, UK, Canada, Brazil, Indonesia, Mexico and Australia. A newly developed communications satellite, the HS393, will become operational in 1989. The company is also developing the high-power HS601, its first three-axis stabilized craft. Approximately 50% of all current commercial communications satellites have been built by Hughes. In addition to commercial communications satellites, Hughes also designs and produces military communications, meteorological, and scientific satellites (GOES and Leasats). To maintain contact with its commercial satellites, Hughes designs, develops, builds

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[313]This appendix information comes from the "Jane's Space Flight Directory," Jane's Information Group, 1988 [Ref.10]. The following references are listed in the Chapter Five, BRASILSAT Program Case.

and commissions telemetry, command and satellite control ground terminal facilities on a worldwide basis. The company also supplies components to organizations building their own ground stations.

MCDONNELL DOUGLAS

McDonnell Douglas Astronautics Company is located in Huntington Beach, California. The company is deeply involved in the NASA Space Transportation System and plays a multiple role with the production of Shuttle hardware, flight training and mission programming and payload integration. This includes building the aft and forward skirts, frustrum and other structures for the solid rocket boosters, and the aft propulsion system consisting of an orbital maneuvering system and reaction control system. MacDonnell Douglas builds the DELTA launch vehicle and has supplied large numbers of these to NASA, the 179th launch occurring in September 1986, with nearly 200 satellites being placed in orbit over the past 25 years. NASA restarted the production line in September 1986 in response to the need for expendable launchers recognized in the wake of Challenger's accident. Several launches are scheduled in January 1987 as the USAF Medium Launch Vehicle. The company has also designed and produced the Payload Assist Module (PAM) to launch unmanned satellites towards higher orbits from the cargo bay of the shuttle vehicle. This module, which has also been used as the upper stage of the later DELTA rockets, was developed as the world's first commercial space launch vehicle and has already placed about 30 communications satellites into high orbit.

SPAR AEROSPACE LIMITED

Spar Aerospace Limited, specifically its Satellite and Aerospace Systems Division, located in Ste. Anne de Bellevue, Quebec, is a prime contractor for NASA's Remote Manipulator System (Canadarm), Telesat Canada's Communications satellites, and the communications satellite system for Brazil. As a prime contractor, Spar leads a team of Canadian aerospace companies in developing and building the Mobile Servicing Centre, Canada's contribution to NASA's International Space Station. In its plant, Spar designs and manufactures subsystems, including a range of antennas such as C and Ku-band, TT & C, VHF, X-band telemetry and Ku-band reconfigurable antennas. Transponder subsystems include search and rescue transponders, 4 GHz transmitters, linear high power amplifiers, input filters, band pass filters and 6/4 GHz communications filters. Other products include on-board microprocessors, thermal actuators, converters, power conditioners, filters and duplexes.

ARIANESPACE

Following the collapse of ELDO and the failure of the Europa rocket based upon Blue Streak, France launched the Ariane program in 1972. The Ariane program was declared operational on 25 January 1982. It is developed by 10 European nations as a French insistence that Europe should have the ability to launch its own satellites and not rely upon the U.S. or the Soviet Union. Arianespace was formed in 1980 by 36 European aerospace companies and 13 banks to take over production and launch operations as soon as ESA (European

Space Agency) had completed four test and six production launches[314]. Arianespace continued to benefit from the ever longer NASA delays resulting from the Challenger disaster[315]. By 1987, the company had 42 satellite launch contracts worth about $2,000 million, in addition to the 14 already successfully launched. By October 1987, Arianespace had ordered 39 launchers (17 Ariane 1s and 2s and 21 Ariane 4s) plus long term supply for 6 more. The increased production rate was expected to lead to the total of 6,000 European workers at Ariane rising to 10,000 by the end of decade. All Ariane launches are from French Guiana Space Center, Korou.

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[314]By 1981, Ariane was ESA financed and managed by CNES (Centre National d'Etudes Spatiales) with industrial facilities by Aérospatiale; the Ariane final production, marketing and launching were the responsibility of Arianespace [Ref. 10:p. 436].

[315]India was among customers which apparently felt that NASA, with vague offers of a Delta launch if the Shuttle was not available, had ceased to be reliable. With the Challenger out of business, it would capture 50% of the estimated 20 satellites launches per year [Ref. 10:p. 436].

LIST OF REFERENCES

CHAPTER 1 - INTRODUCTION

1. Office of Management and Budget, The Annual Report of Impact of Offsets in Defense-Related Exports: 4th report, December 1988, OMB, Washington, DC.

2. Department of the Treasury / The Aerospace Industries Association / The Eletronic Industries Association, Report of a Survey on Offset and Coproduction Requirements, 24 March, 1983.

3. Neuman, Stephanie G., "Coproduction, Barter and Countertrade: Offsets in the International Arms Market," Orbis, pp.183-213, Spring 1985.

4. Offset Agreements, Subcommittee on Economic Stabilization of the Committee on Banking, Finance and Urban Affairs House of Representatives, Hearing, 18 June, 1986.

5. Office of Management and Budget, The Impact of Offsets in Defense-Related Exports: A Summary of The First Three Annual Reports, December, 1987, OMB, Washington, DC.

6. Bermejo, Jose Angel C., "U.S. must realize its Allies Need to Benefit from Technology Advances," Aviation Week & Space Technology, p.151, 12 September,1988.

7. Herbert Wulf, Arms production in the Third World in World Armaments and Disarmament, Stockholm International Peace Research Institute - SIPRI Yearbook, London: Taylor and Francis, 1985.

8. Arms Control and Disarmament Agency, World Military Expenditures and Arms Transfers, ACDA, 1987.

9. Walker, Karen, "Tucano Takes Off With Tiny Times", Jane's Defence Weekly, 20 August, 1988.

10. Schmidt, Rachel, Defense Offsets: Production Sharing And Countertrade In U.S. Arms Sales, California Seminar on International Security and Foreign Policy Discussion, Paper no.10, May 1989.

11. Babbie, Earl, The Practice of Social Research, Wadsworth Publishing Company Belmont, California, 1983.

12. George, Alexander L., Case Studies and Theory Development: The Method Of Focused Structured, Focused Comparison (chapter 3)

Lauren Paul G. (ed) Diplomacy New Approaches in History, Theory and Policy, The Free Press, New York, 1979.

13. Yin, Robert K., Case Study Research Design and Methods, Sage Publications, 1984.

14. Brzoska, Michael, "Arms Transfers Data Sources," Journal of Conflict Resolution, v.26, no 1, pp.77-108, March 1982.

15. Laurance, Edward J. and Ronald G. Sherwin "Arms Transfers and Military Capability," International Studies Quarterly, v.23, no.3, p.360-389, September 1979.

16. Laurance, Edward J. and Ronald G. Sherwin, "Understanding Arms Transfers Through Data Analysis," chapter 4, U. Ra'anan et al (ed.s) Arms Transfers the Third World: The Military Build-up in Less Industrialized Countries, Bolder, Co, 1978.

17. Kolodziej, Edward A. "Measuring French Arms Transfers," Journal of Conflict Resolution, v.23. no. 2, pp.195-227, June 1979.

18. U.S. Deparment of Defense, The Management of Security Assistance Manual, 1988.

19. Louscher, David J.,Marketing Security Assistance, New Perspectives on Arms Sales, Lexington Books, 1987.

20. Katz, James Everett, Arms Production in Developing Countries, an Analysis of Decision Making. Lexington Books, 1984.

21. Well, Leo G.B., "Military Offsets", National Defense, v.6, no 396, March 1984.

22. Organization for Economic Cooperation and Development (OECD), Countertrade: Developing Country Practices, The OECD Catalogue of Publications, Paris, 1985.

23. Business International Corporation, Threats and Opportunities of Global Countertrade, One Rag Hammarskjold Plaza, New York, NY, 10017, 1984.

24. U.S. Department of Commerce (DOC), International Countertrade: A Guide for Managers and Executives, DOC, November 1984.

25. Banks, Gary, "The Economics and Politics of Countertrade", The World Economy Journal, v.6, no.2 pp159-182, June 1983.

26. Mirus, Rolf, and Yeung, Bernard, "Economic Incentives For Countertrade," Journal of International Business Studies, Fall 1986.

27. Hennart, Jean-Francois, "The Transaction-Cost Rationale for Countertrade," Journal of Law, Economics, and Organization, v.15, no. 1, pp.127-153, Spring 1989.

28. Korth, Christopher M., International Countertrade, Quorum Books, 1987.

29. Verzariu, Pompiliu, Countertrade, Barter, and Offsets: New Strategies For Profit In International Trade, McGraw-Hill Book Company, 1985.

30. Jones, Stephen F. "North-South Countertrade," The Economic Intelligence Unit, Special Report no. 174, 1984.

31. Schaffer, Matt, Winning the Countertrade War: New Export Strategies for America, John Wiley & Sons, 1989.

32. Welt, Leo G. B., Trade Without Money: Barter and Countertrade, Law and Business Inc., 1984.

33. Maynard, Cathleen E., Indonesia's Countertrade Experience, the American Indonesian Chamber of Commerce, November 1983.

34. Contractor, Farok J., International Technology Licensing, Lexington Books, 1981.

35. Contractor, Farok J. and Franklin R. Root, "Negotiating Compensation in International Licensing Agreements," Sloan Management Review, v.22, no 2, Winter 1981.

36. Rich, Michael and others, Multinational Coproduction of Military Aerospace Systems, Rand Corporation, R2861-AF, October 1981.

37. Hall, G.R., and R.E. Johnson, Aircraft Coproduction and Procurement Strategy, Rand Corporation, R-450-PR, May 1967.

38. Harrigan Kathryn R., Managing for Joint Venture Success, Lexington Books, 1986.

39. Killing, J.Peter, Strategies for Joint Venture Success, Praeger Publishers, 1983.

40. Baranson, Jack, Technology and the Multinational, Lexington Books, 1978.

41. Baranson, Jack, North-South Technology Transfer: Financing and Institution Building, Lomond Publications, Inc., 1981.

42. Rogers, Everett M., Diffusion of Innovations, The Free Press, 1983.

43. Wallender III, Harvey W., Technology Transfer and Management in the Developing Countries: Company Cases and Policy Analyses in Brazil, Kenya, Korea, Peru, and Tanzania, Ballinger Publishing Company, 1979.

44. Singh, Vydia N., Technology Transfer and Economic Development, Unz & Co, New Jersey, 1983.

45. Erber, Fábio Stefano, "Science and Technology Policy in Brazil: A Review of the Literature," Latin America Research Review, v.16, no.1, 1981.

46. The World Bank, Brazil, Industrial Policies and Manufactured Exports, The World Bank, Washington, D.C, 1981.

47. Dagnino, Renato P., "P & D Militar e Desenvolvimento na America Latina," Política e Estratégia, v.2, no 3, July-September 1984.

48. Dagnino, Renato P., "A Indústria de Armamentos Brasileira: Desenvolvimento Perspectivas," Revista Brasileira de Tecnologia, v.14, no 3, May-June 1983.

49. Dagnino, Renato P., "Organização das Forças Armadas e Defesa Externa: Implicações Tecnológicas," Política e Estratégia, v.4, no 2, April-July 1985.

50. Kolodziej, Edward A. and Robert E. Harkavy, Security Policies of Developing Countries, Lexington Books, 1982.

51. McKenna, Charles E., U.S. Department of Defense International Offset Arrangements: Objectives and Impediments, The National War College Master's Thesis, May 1987.

52. Moses, Robert Leslie, Trade Offsets in Foreign Military Sales, the F/A - 18 Program Case Study, NPS Master's Thesis, December 1987.

53. Tollefson, Scott D., Brazilian Arms Sales and Foreign Policy: The Search for Autonomy, NPS working paper, not published.

54. Mura, Jane Dalla, The Effect of U.S. National Interests on Arms Transfer Decision Making in Brazil, NPS Master's Thesis, September 1983.

55. Ellis, Sandra N., Naval Technology Transfer and Arms Trade: The Brazilian Connection, NPS Master's Thesis, June 1988.

56. Reiners, Rockford J., An Examination of Brazil and the United States as Potential Partners in a Joint Supersonic Military Fighter Aircraft Codevelopment and Production Program, AFIT Master's Thesis, September 1986.

57. "South America Military Forces Face Increasing Hardware Needs," Aviation Week & Space and Technology, pp. 40-78, 24 August 1987.

CHAPTER 2 - OFFSET AND TECHNOLOGY TRANSFER CONCEPTS

1. Korth Christopher M., International Countertrade, Quorum Books, 1987.

2. Neuman, Stephanie G. "Coproduction, Barter and Countertrade: Offsets in the International Arms Market", Orbis, pp.183-213, Spring 1985.

3. Office of Management and Budget (OMB), The Annual Report of Impact of Offsets in Defense-Related Exports: 4th Report, OMB, Washington, DC, December 1988.

4. McKenna, Charles E. U.S. Department of Defense International Offset Arrangements: Objectives and Impediments, The National War College Master's Thesis, May 1987.

5. Business International Corporation (BIC), Threats and Opportunities of Global Countertrade, One Dag Hammarskjold Plaza, New York, NY, 1984.

6. Office of Management and Budget (OMB), Impact of Offsets in Defense-Related Exports: A Summary of the First Three Reports, OMB, Washington, DC, December 1987.

7. Department of Treasury, The Aerospace Industries Association, The Electronics Industry Association, (DT/AIA/EIA), Report of a Survey on Offset and Coproduction Requirements, 24 March 1983.

8. Government Accounting Office (GAO), Trade Offsets in Foreign Military Sales, GAO/NSIAD 84-102, 13 April 1984.

9. Brzoska, Michael and Thomas Ohlson, Arms Transfers to the Third World 1970-1985, SIPRI, 1986.

10. White, Justus P., "Congress Two-Way Street Initiation: Good But Misdirected Intentions", Armed Forces Journal International, Dec. 1988.

11. Singh, Vidya N., Technology Transfer and Economic Development, Unz & Co, New Jersey, 1983.

12. Barason, Jack,"Technology Transfer Through the International Firm", American Economic Review, v.9, no.2, May 1970.

13. Hennart, Jean-Francois, "The Transaction-Cost Rationale for Countertrade", Journal of Law, Economics, and Organization, v.5, no.1, pp. 127-153, Spring 1989.

14. McLeavy, Roy, "Brazil to Barter Iron for Submarines", Jane's Defense Weekly, 17 March 1984.

15. Possas, Mario Luiz, Multinational Enterprises Technology and Employment in Brazil: Three Case Studies, Working paper no. 21, International Labour Organisation, Geneva, 1982.

16. Banks, Gary, "The Economics and Politics of Countertrade", The World Economy Journal, v.6 no.2, pp. 159-182, June 1983.

17. Morrison, David C., "Have Weapons, Will Trade", National Journal, v.18, no.13, pp. 763-767, 29 March 1986.

18. Louscher, David J. and Michael D. Salomone, Marketing Security Assistance, New Perspectives on Arms Sales, Lexington Books, 1987.

19. Chan, Steve, "The Consequences of Expensive Oil on Arms Transfers", Journal of Peace Research, v.17, no.3, 1980.

20. Katz, James Everett, Arms Production in Developing Countries, an Analysis of Decision Making, Lexington Books, 1984.

21. Hilton, Stanley E. "The Brazilian Military: Changing Strategic Perceptions and the Question of Mission", Armed Forces & Society, v.13, no.3, pp.329-351, Spring 1987.

22. Tollefson, Scott D., Brazilian Arms Sales and Foreign Policy : the Search for Autonomy, NPS working paper, not published.

23. "Aeronautics Director Discusses Agreement with the U.S." O Estado de São Paulo (in Portuguese), 19 December 1984, p.2, FBIS-LAT 24, December 1984.

24. U.S. Department of Transportation (USDOT), The Brazilian Aircraft Industry, Report, June 1985.

25. Neuman, Stephanie G., "International Stratification and Third World Military Industries," International Organization, v.38, no.1, Winter 1984.

26. Verzariu, Pompiliu, Countertrade, Barter, and Offsets: New Strategies for Profit in International Trade, McGraw-Hill Book Company, 1985.

27. Organization for Economic Cooperation and Development (OECD), East-West Trade, Recent Developments in Countertrade, OECD, Paris, 1981.

28. Murrel, Peter, "Product Quality, Market Signaling and the Developing of East-West Trade," Economic Inquiry, v.20, pp.589-603, October 1982.

29. Wallender III, Harvey W. Technology Transfer and Management in the Developing Countries: Company Cases and Policy Analyses in Brazil, Kenya, Korea, Peru, and Tanzania, Ballinger Publishing Company, 1979.

30. Department of Defense (DOD), The Security Assitance Management Manual, 1988.

31. Doctors, Samuel I., The Role of Federal Agencies in Technology Transfer, MIT Press, 1969.

32. Bass, Lawrence W., The Management of Technical Programs, Frederick A. Prager, 1966.

33. Wallender III, Harvey W., "Developing Country Orientations Toward Foreign Technology in Eighties: Implications for New Negotiation Approaches", Columbia Journal Of World Business, v.15, no.12, Summer 1980.

34. Welles, John G. and Robert H. Waterman Jr., "Space Technology Payoff from Spinoff, Harvard Business Review, pp.106-118, July/August 1968.

35. Hall, G.R. and R.E. Johnson, Transfers of United States Aerospace Technology to Japan, the Technology Factor in International Trade, ed. by Raymond Vernon, National Bureau of Economic Research, 1970.

CHAPTER 3 - GOVERNMENT OFFSET POLICIES

1. Trade Offsets in Foreign Military Sales, GAO/NSIAD 84-102, 13 April 1984.

2. The U.S. Secretary of Defense, General Policy on Compensatory Coproduction and Offset Agreements with Other Nations, Memorandum, Washington, DC, 4 May 1978.

3. White, Justus P., "Congress Two-Way Street Initiation: Good but Misdirected Intentions," Armed Forces Journal International, p.20, December 1988.

4. Silverberg, David, "U.S. Sets First-Time Ceiling on Trade Offsets," Defense News, p.1, 14 August 1989.

5. Silverberg, David, "Korea Agrees to U.S. Offset Ceiling," Defense News, p.81, 18 September 1989.

6. Silverberg, David, "Turkish Defense Program Stresses Direct Offset," Defense News, p.28, 26 September 1988.

7. Schleider III, Benjamin H., "Trading for Influence, U.S. Foreign Policy and Defense-Related Offsets," Journal of Defense & Diplomacy, v.5, no.1, p.15, 1987.

8. Berry Jr., F. Clifton.,"British Offset Policy," National Defense, pp.31-33, May/June 1989.

9. Business International Corporation (BIC), Threats and Opportunities of Global Countertrade, One Dag Hammarskjold Plaza, New York, NY, 1984.

10. Maynard, Cathleen E.,"Indonesia's Countertrade Experience," The American Indonesian Chamber of Commerce, November 1983.

11. Maynard, Cathleen E., "Indonesia's Countertrade Experience: An Update," The American Chamber of Commerce, December 1984.

12. Schaffer, Matt., Winning the Countertrade War: New Strategies for America, John Willey & Sons, 1989.

13. U.S. Department of Commerce - International Trade Administration, Marketing in Brazil, OBR 89-08, August 1989.

14. The World Bank, Brazil, Industrial Policies and Manufactured Exports, The World Bank, Washington, DC, 1981.

15. Wallender III, Harvey W.Technology Transfer and Management in the Developing Countries: Company Cases and Policy Analyses in Brazil, Kenya, Korea, Peru, and Tanzania, Ballinger Publishing Company, 1979.

16. "Brazilian Export Policy Sparks Criticism", Aviation Week & Space and Technology, p.60, 21 June 1982.

17. 1989 National Trade Estimate Report on Foreign Trade Barriers, Office of the U.S. Trade Representative. U.S. Government Printing Office, Washington, DC, 1989.

18. Carl, Beverly May, "The Brazilian Aircraft Industry and the Use of Law as a Tool for Development," Journal of Air Law and Commerce, v.50, no.3 & 4, pp. 513-83, 1985.

19. Green, Ronald D. and others, Brazilian Government Support for the Aerospace Industry, U.S. Department of Commerce, International Trade Commission (ITC), March 1987.

20. GATT to Rule on U.S. Claims of Unfair Trade, O Estado de São Paulo (in Portuguese), p.3, 25 June 1989, FBIS-LAT-89- 123, 28 June 1989.

21. U.S. Backs Bid For Brazilian Satellite Deal, Financial Times, 18 July 1989.

22. Ellis, Sandra Nichols, Naval Technology Transfer and Arms Trade: The Brazilian Connection, NPS Master's Thesis, Monterey, California, June 1988.

23. "U.S. Backs Bid for Brazilian Satellite Deal," Financial Times, 18 July 1989.

CHAPTER IV - THE BRAZILIAN AEROSPACE INDUSTRY

1. The Brazilian Aircraft Industry, Washington, DC, USDOT, Report, June, 1985.

2. Kolcum, Edward H. and Cocoa Beach, "Economic Pressures Shape South American Defense Issues," Aviation Week & Space Technology, 14 March, 1988.

3. "The Party's Over, Brazilians Scrambles for Markets in Brave New World of High Tech," Defense News, 23 March, 1987.

4. Tollefson, Scott D. Brazilian Arms Sales and Foreign Policy: The Search for Autonomy, NPS working paper, not published.

5. Franko-Jones, Patrice, "Public Private Partnership Lessons from The Brazilian Armaments Industry," Journal of Interamerican Studies and World Affairs, v.29, no.4, pp. 41-68, Winter 87/88.

6. Ramamurti, Ravi. "Empresa Brasileira de Aeronáutica S.A (EMBRAER)," Management in the International Economy, Raymond Vernon, ed., Prentice-Hall, 1986.

7. Williams, John Hoyt, "Aerospace Boom in Brazil," Air Force Magazine, June 1985.

8. Jane's All the World's Aircraft, Jane's Defense Data, 1988-89.

9. Hudson, Rex, Brazil's Foreign Military Sales (FMS) Program, Defense Intelligence Agency, 31 January 1985.

10. Carl, Beverly May, "The Brazilian Aircraft Industry and The Use of Law as a Tool for Development," Journal of Air Law and Commerce, v.50, no.3 & 4, pp.513-83, 1985.

11. Carl, Beverly May, "The Brazilian Experiment in The Creation of an Aircraft Industry," Journal of Air Law and Commerce, v.38, no.1, 1972.

12. Brazilian Government Support for The Aerospace Industry, U.S. Department of Commerce, ITC, March 1987.

13. Grangier, Marg, "The Embraer Bandeirante's Spetacular Progress," Interavia, no.12, 1978.

14. "Sales Results Cause Embraer to High Brasilia Delivery Rates," Aviation Week & Space Technology, 9 November 1987.

15. Jane's All The World's Aircraft, Jane's Defense Data, ed. 1974-75 and ed. 1988-89, 1988.

16. "Turbulência no Ar," Revista Veja, pp.122-123 (in Portuguese), 14 June 1989.

17. Embraer Announces Plans for New Airplane, FBIS-LAT-89-124, 29 June 1989.

18. Revuelta, Klaus Wolff-Casado, "The Brazilian Defence Industry - Partner or Competitor to The Established Western Defence Industries?," Military Technology, pp. 92-117, no.10, 1985.

19. "South America Military Forces Fact Increasing Hardware Needs," Aviation Week & Space Technology, p.40, 24 August 1987.

20. North, David M., "Brazil Plans to Launch Its Own Satellite," Aviation week & Space Technology, p.60-61, 9 July 1984.

21. "Satellite Launch Construction Under Way," O Globo, p.6, 14 October 1987, (in Portuguese), FBIS-LAT-87-201, 19 October 1987.

22. "Alcântara Site of New Rocket Launching Center", Brasilia, Empresa Brasileira de Notícias 27 May 1988 (in Portuguese), FBIS-LAT-88-109, 7 June 1988.

23. Budget Axe Hangs Over Satellite, Latin American Weekly Report WR 88-40, pp.8-9, 13 October 1988.

24. Tatical Missile Development Reported, FBIS-LAT-88-002, 5 January 1988.

25. "Obstacles to VLS Development Reviewed," Folha de São Paulo, p.63, 14 July 1989 (in Portuguese), FBIS-LAT-89-156, 15 August 1989.

26. "O Espaço Deve Ser Civil," Interview with Marco Antonio Raupp, Revista Veja, (in Portuguese), pp.5-8, 8 February 1989.

27. "Europe Launches Ariane V17 from New ELA - 2 Facility," Aviation Week & Space Technology, p.20, 7 April 1986.

28. Gilson, Charles, "Can Offset Work for Greece?," Interavia, December 1988.

29. Shuey, Robert D. and others, Missile Proliferation: Survey of Emerging Missile Forces, Congressional Research Service, The Library of Congress, 3 October 1988.

30. Calton, Augusto, "Brazil's Growing Missile Industry," Jane's Defence Weekly, 5 March, 1988.

31. Ministério da Ciência e Tecnologia," Ciência e Tecnologia no Brasil: Evolução e Recente Perspectivas," Conselho Nacional de Pesquisas (CNPq), Document presented in a II Conference of Latin America and Caribe Science and Technology Ministries, CASTALA II, Brasília, D.F., pp. 20-26, August 1985.

32. North, David A., "NTSB Scrutinizes Stabilizer Loss in Crash of Bandeirante," Aviation Week & Space Technology, 17 December, 1984.

33. Pirard, Theo, "Buy, Buy Brazil", Satellite Communications, March 1988, p.33-37.

34. "Brazilian Satellite Systems", Signal Forces Communications & Electro, v.37, issue 4, p.138, December 1982.

35. "Brazil, Iraq to developed Rockets Jointly" O Globo, (in Portuguese), 19 March 86, p.46, FBIS-LAT-89-065, 6 April 1989.

36. "Libya Offers to Finance Brazilian Missile Project," Jane's Defense Weekly, 6 February 1988, p.201.

37. Hollinger, Frederick J., "The Missile Technology Control Regime: Major New Arms Control Achievement," World Military Expenditures and Arms Transfers, U.S. Arms Control Disarmament Agency, Washington, DC, 1987.

38. Interview with Mr. J.M. Palsulich, BRASILSAT Proposal Manager, McDonnell Douglas Commercial Delta Inc., 12 October 1989.

39. "Brazilian Satellite System Bids Accepted," Aviation Week & Space and Technology, 12 July 1976, p.47.

40. "Two Home-Owned Satellites Will Soon Orbit over Brazil," Data Communications, v.13, no.3 pp. 58-62, March 1984.

41. Bulloch, Chris, "BRASILSAT a Good Investment that Justifies its Cost," Interavia Space Markets, no.2, pp. 112-114, Summer 1986.

CHAPTER 5 - BRAZILIAN AEROSPACE OFFSET CASES

A. COUNTERTRADE

1. The MD-11 Aircraft Case

1. "VARIG Proposers in Difficult Region," New York Times, p.24, 9 May 1988.

2. "VARIG Investe US $1 Bilhão Em Aviões Novos," O Estado de São Paulo, 19 March, 1987.

3. Jane's All The World's Aircraft, Jane's Defense Data, ed. 1988-89, p.466, 1988.

4. McDonnell Douglas, 1988 Annual Report, p.11.

5. "VARIG Lays Ground Work for Coordination of Winning Ways," Air Transport World, v.24, issue 2, pp. 90-96, February 1987.

6. "Embraer Et Le MD 11," Air et Cosmos, issue 1148, p.67, 20 June, 1987 (French).

7. Interview with Mr. Stevie Lewis, Manager, Countertrade & Offset Programs, McDonnell Douglas, 12 October 1989.

8. "Materiaux Et Production: Embraer va Fabrioner Des Volets de MD 11," Air Et Cosmos, issue 1149, p. 21, 27 June 1987.

9. Interview with Mr. J.B. Melges, International Program Development Director, McDonnell Douglas, 13 October 1989.

10. "Brazilia: EMBRAER's New Commuter," Flight International, pp. 254-9, 30 July 1983.

11. Hammond, Grant T., "Offsets, Arms, and Innovation", The Washington Quarterly, v.10, no.1, Winter 1987.

12. Green, Ronald. and others, Brazilian Government Support for the Aerospace Industry, U.S. Department of Commerce, International Trade Commission, March 1987.

13. "Brazil's Defense Finds a World," Defense & Foreign Affairs, March 1986, pp. 8-11.

B. TECHNOLOGY TRANSFER

1. The BRASILSAT Program Case

1. Interview with Mr. J.M. Palsulich, BRASILSAT Proposal Manager, McDonnell Douglas Commercial Delta Inc., 12 October, 1989.

2. Condom, Pierre, "Brazilian Aerospace Comes of Age," Interavia, no 12, 1984.

3. Turner, Rik, "Offsets Drive Bidding in Brazil," Satellite Communications, p. 42, June 1989.

4. Hollinger, Frederick J., "The Missile Technology Control Regime: Major New Arms Control Achievement," World Military Expenditures and Arms Transfer, U.S. Arms Control and Disarmament Agency, 1987.

5. "France-Brazil Space Deal Attack," Flight International, 12 August, 1989.

6. "Two Home-Owned Satellites Will Soon Orbit Over Brazil," Data Communications, v.13, no.3, pp. 58-62, March 1984.

7. North, David M., "Brazil Plans to Launch Its Own Satellite," Aviation Week & Space Technology, pp. 60-1, 9 July 1984.

8. "Brazil Space Funds," Aviation Week & Space Technology, p. 70, 13 December 1982.

9. "BRASILSAT: A Good Investment That Justifies Its Cost," Interavia Space Markets, no.2, Summer 1986.

10. "Jane's Space Flight directory," Jane's Information Group, 1988.

11. "Exim Bank Insures Brazilian Satellites," Aviation Week & Space Technology, p. 66, 17 December 1984.

12. "West Europeans Seek to Joint Brazil in Production of Arms," Washington Post, p. A17, 8 May 1978.

13. "O Espaço Deve Ser Civil," Interview with Marco Antonio Raupp, (in Portuguese), Veja, pp. 5-8, 8 February 1989.

14. "Obstacles to VLS Development Reviewed," Folha de São Paulo, (in Portuguese), p. 63, 14 July 1989, FBIS-LAT-89-156, 15 August 1989.

15. "Alcântara Site of New Rocket Launching Center," Brasilia, Empresa Brasileira de Notícias, FBIS-LAT-88-109, 7 June 1988.

16. "Rocket Launched Brazilian Domestic Service (in Portuguese), p. 23, FBIS-LAT-87-199, 15 October 1987.

17. Turner, Rik, "The Bidding in Brazil," Satellite Communications, pp. 14-5, February 1989.

18. "Embraer Expands Capabilities to Use Composites," MetalWorking News, p. 36, 5 October 1987.

C. LICENSED PRODUCTION

1. The PIPER General Aviation Planes Case

1. Baranson, Jack, North-South Technology Transfer, Lomond Publications, Inc., 1981.

2. Baranson, Jack, Technology and the Multinationals, Lexignton Books, 1988.

3. Brazilian Government Support for The Aerospace Industry, U.S. Department of Commerce, ITC, March 1987.

4. Carl, Beverly May, "The Brazilian Aircraft Industry and The Use of Law as a Tool for Development," Journal of Air Law and Commerce, v.50, no.3 & 4, pp. 513-83, 1985.

5. Hudson, Rexford A., "The Brazilian Way to Technological Independence: Foreign Joint Ventures and The Aircraft Industry," Inter-American Economic Affairs, v.37, issue 2, pp.23-43, Autumn 83.

6. "Piper Kits Sold," Aviation Week & Space Technology, p. 38, 4 August 1986.

7. "Embraer Buys More Piper Kits," Flight International, p.13, 9 August 1986.

8. Ramamurti, Ravi, "Empresa Brasileira de Aeronáutica S.A (EMBRAER)," Management in the International Economy, Raymond Vernon, ed., Prentice-Hall, 1986.

9. Moxon, Richard and others, Emerging Sources of Foreign Competition of The Civil Aircraft Manufacturing Industries, U.S Department of Transportation, June 1985.

10. Jane's All The World's Aircraft - 1974-75, Jane's Defense Data, 1974.

11. Jane's All The World's Aircraft - 1988-89, Jane's Defense Data, 1988.

12. "Brazil Presses to Build Aircraft Industry," Aviation Week & Space Technology, 6 January 1975.

13. "Brazil, Argentina May Unit Piper Mart, Split Production," Journal of Commerce, 15 May 1989.

2. The Aérospatiale Military Helicopters Case

1. Turner, Rick, "Aerospatiale, Brazilian Partners Win $246 Million Copter Contract," Defense News, no.3, February 1988.

2. "Brazil Announces Helicopter Venture," Flight International, v.129, issue 4008, p.1, 26 April, 1986.

3. "O Primeiro Batalhão de Aviação do Exército," Verde Oliva, (in Portuguese), no. 124, pp.12-13, Centro de Comunicação Social do Exército, August 1989.

4. Briganti, Giovani de, "French Offset Agreement With Brazil Complicates Helicopter Sales to Swiss," Defense News, no.41, 3 October 1988.

5. Telephone conversation with Mr. Nivaldo Alves da silva, Manager of the HELIBRAS Offset Office in Marcelle, France, 18 August 1989.

6. Jane's All the World's Aircraft, Jane's Defence Data, ed. 1988-89, 1988.

7. Brazilian Defence Equipment 1988-1989, Fundação Visconde de Cabo Frio, Biannual, Brasília, DF, 1983.

8. Brzoska, Michael and Thomas Ohlson, Arms Tranfers to the Third World 1970-1985, SIPRI, 1986.

9. "FAMA Construirá Helicópteros Augusta," Segurança e Defesa (in Portuguese), no.20, p. 8, 1988.

10. Turner, Rick. "Brazil Ministry Plans to Accept Bids for Army Helicopter Supply Deal," Defense News, 15 October 1987.

11. "South American Companies Seek for Assure Sustained Growth," Aviation Week & Space Technology, p. 40, 17 August 1987.

12. "Engesa Joining Helibras," Defense & Foreign Affairs Weekly, v.13, issue 17, pp. 3-4, 10 May 1987.

13. "Aérospatiale Leads Helicopter Exports," Flight International, v.129, issue 4008, p. 1, 26 April 1986.

14. "Brazilian Army Weighs Bids on Future Helicopter Program," Aviation Week & Space Technology, v. 129, issue 4, p. 24, 25 January 1988.

15. "Embraer Buys More Piper Kits," Flight International, p. 13, 9 August 1986.

D. COPRODUCTION/CODEVELOPMENT

1. The CBA-123 Paraná Commuter Plane Case

1. "Production of EMB-123 by 1990," Latin America Regional Reports, RB-86-06, 10 July 1986.

2. Katz, James Everett, Arms Production in Developing Countries: An Analysis of Decision-Making, Lexington Books, 1984.

3. Kolodziej Edward A. and Robert E. Harkavy, Security Policies of Developing Countries, Lexington Books, 1982.

4. Milenky, Edward S., "Arms Production and National Security in Argentina," Journal of Interamerican Security and World Affairs, v.22, no.3, pp. 267-288, August 1980.

5. Hilton, Stanley E., "The Argentina Factor in the Twentieth-Century Brazilian Foreign Policy Strategy," Political Science, Quarterly, v.100, no.1, pp. 27-51, Spring 1985.

6. Brzoska, Michael and Thomas Ohlson, Arms Production in The Third World, SIPRI, 1986.

7. Selcher, Wayne A., "Brazilian-Argentine Relations in the 1980s: From Many Rivalry to Friendly Competition," Journal of Interamerican Studies and World Affairs, pp. 25-53, v.27, no.2, Summer 1985.

8. "Industrie-Carnet: Flashes:Industrie: EMBRAER," Air et Cosmos, (in French), issue 1094, p. 9, 3 May 1986.

9. "Agreement Signed with Argentina to Build Plane," TELAM, Buenos Aires, 22 May 1987.

10. Grangier, Marg, "The EMBRAER Bandeirante's Spectacular Progress," Interavia no.12, 1978.

11. EMBRAER General Information, Brazilian Aeronautical Industry, São José dos Campos, São Paulo, 1988.

12. "EMBRAER on The Growth," Air Transport World, issue 3, pp. 91-5, 1987.

13. "Research & Development CBA-123 Without Direct Competition," Interavia Air Letter, pp. 6-7, 27 June 1988.

14. Lynch, David J., "Brazilian Firm Making Plans for Supersonic Training Jets," Defense News, 16 March 1987.

15. "EMBRAER/FAMA Select Garret to Power CBA-123," Interavia Air Letter, p. 5, 21 September 1987.

16. "EMBRAER Reveals Details of The CBA-123," Air International, v. 31, issue 4, p. 170, October 1986.

17. "Options For CBA-123," Commuter World, v. 5, issue 5, p. 55, October 1988.

18. "Industrie et Technique: EMBRAER: Un Remplacant du Bandeirante," Air et Cosmos, (in French), issue 1096, p. 21, 17 May 1986.

19. Janes's All the Worlds Aircraft - 1988-89, Janes's Defence Data, 1988.

20. "News Brief: CBA -123 Work Sharing," Canadian Aviation, v. 61, issue 8, p. 21, August 1988.

21. "The Week: Argentina May Reject Tucanos," Jane's Defence Weekly, v. 5, issue 7, p. 307, 22 February 1986.

22. Done, Kevin, "Autolatina to Invest DM4bm," Financial Times, 30 June 1989.

23. Lambert, Mark, "EMBRAER Almost at The Top of The Climb," Interavia, no.5, 1988.

24. "Sales Results Cause EMBRAER to High Brasîlia Delivery Rates," Arms Control and Disarmament Agency, 9 November 1987.

25. "Argentina's IA-63 Stepping Stone to 1990s Technology," interavia 4, p. 367, 1984.

26. "EMBRAER, French Company Win Military Contract," Brasîlia Domestic Service, (in Portuguese), 14 August 1989, FBIS-LAT-89-157, 16 August 1989.

27. "Economic Outlook Grim For Brazil" Argentina Journal of Commerce, 28 July 1989.

28. "Brazilian Government Support for The Aerospace Industry," U.S. Department of Commerce, ITC, March 1987.

2. The AMX Fighter Aircraft Case

1. "FAMA Construirá Helicópteros Augusta," Segurança e Defesa (in Portuguese), no. 20, p. 8, Brasil, 1988.

2. EMBRAER AMX, The Only Choice, A descriptive brochure on the AMX aircraft, São José dos Campos, Brazil, 1989.

3. Jane's All The World's Aircraft - 1988-89, Jane's Defence Data, 1988.

4. Wanstall, Brian, "Production-line AMX," Interavia, no.6, pp. 581-593, 1989.

5. Reiners, Rockford J., An Examination of Brazil and The United States as a Potential Partners in a Joint Supersonic Military Fighter Aircraft Codevelopment and Production Program, AFIT Master's Thesis, September 1986.

6. Condom, Pierre, "Brazil Moves to Make Engines," Interavia, no. 7, 1986.

7. Riding, Alan, "Brazil Burgeoning Arms Industry," The New York Times, 3 November 1985.

8. "Está Chegando a Hora," Segurança e Defesa (in Portuguese), no.20, p. 8, 1988.

9. "AMX: Cornerstone of Future Brazilian Airpower," Defence Today, issue 62, pp. 221-6, June 1983.

10. Kolcum, Edward H., and Beach, Cocoa, "Economic Pressures Shape South America Defense Issues," Aviation Week & Space Technology, 14 March 1988.

11. EMBRAER Annual Report 1987, São José dos Campos, Brazil, 1987.

12. EMBRAER - Facts & Products, EMBRAER, São José dos Campos, Brazil, 1989.

13. "EMBRAER Reveals Details of The CBA-123," Air International, v.31, issue 4, p. 170, October 1986.

14. Ministry Cuts Money For Air-to-Air Missile, FBIS-LAT-88-128, 5 June 1988.

15. "EMBRAER Ships First AMX Production Assemblies to Aeritalia," Defence & Foreign Affairs Daily, v.16, issue 179, p. 1, 18 September 1987.

16. North, David M., "EMBRAER Expands Its Facilities for Two New Aircraft," Arms Control and Disarmament Agency, 22 August 1983.

17. "Turbulência no Ar," Revista Veja (in Portuguese), pp. 122-123, 14 June 1989.

18. Ellis, Sandra Nichols A., Naval Technology Transfer and Arms Trade : The Brazilian Connection, NPS Master's Thesis, June 1988.

19. Supersonic Jet Trainer Fighter Planned, FBIS-LAT-88-101, 25 May 1988.

20. Miller, Morton S., "Conventional Arms Trade in the Developing World, 1977-1986," World Expenditures and Arms Transfers, U.S. Arms Control Disarmament Agency, 1987.

21. "Washington Round Up: Bartering Oil," Aviation Week & space Technology, v.122, issue 27, p. 17, 22 October 1984.

22. "PRC Buying Brazilian Weapons," Defence & Foreign Affairs Weekly, v.11, issue 44, p. 2, 17 November 1985.

23. "Argentina/Brazil: Cooperation Pacts," Defence & Foreign Affairs Daily, v.14, issue 236, p. 2, 9 December 1985.

24. Hudson, Rex, "Brazil Foreign Military Sales (FMS) Program," Defence Intelligence Agency, 31 January 1985.

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21. Mr J.M. Palsulich 1
BRASILSAT Proposal Manager
McDonnell Douglas Commercial Delta, Inc.
5301 Bolsa Ave.
Huntington Beach, CA 92647

22. Mr. Stevie Lewis 1
Manager - Countertrade & Offset Programs
Douglas Aircraft Company
Internal Mail Code 77-100
5555 Garden Gove Blvd.
Westminster, CA 92683

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Executive Office of the President
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Brasília, D.F., Brazil 70045

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Institute on International Change
Columbia University
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New York, NY 10027

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